SEVENTY-FOURTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVIII. NUMBER 3] NEW YORK, JANUARY 19, 1918 [10 CENTS A COPY $4.00 A YEAR

Copyright by Munn & Co., Inc.

It takes 50,000 articles to equip the British army—Here are a few of the items and the quantities required [See page 71]

SCIENTIFIC AMERICAN

Founded 1845

Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, January 19, 1918

Charles Allen Munn, President, Frederick C. Beach, Secretary. Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

Copyright 1917 by Munn & Co., Inc.
Great Britain rights reserved
Illustrated articles must not be reproduced without permission

The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

President Wilson on the Freedom of the Seas

IN the course of his masterly address before the House and Senate, setting forth the fourteen terms of peace for which we are "willing to fight until they are achieved," President Wilson stated that the United States stands for "absolute freedom of navigation upon the seas, outside territorial waters, alike in peace and war, except as the seas may be closed in whole or in part by international action for the enforcement of international covenants."

Now, this, the true freedom of the seas, is a very different matter from the freedom of the seas which Germany is seeking to bring about.

We stated in our editorial upon this subject, last week, that Germany has never given any clear statement of what she intended by the phrase; and it is certain that no formal definition has ever been made by the German Government.

But although the Government, for obvious reasons, has been silent, one of Germany's leading naval and military critics, Count Reventlow, has declared his interpretation of the phrase in terms which remove the last vestige of doubt as to what he and, it is reasonable to suppose, the German Government has in mind. For Prof. Selfton Delmer, who was present at a mass meeting in Berlin last March, when the Count lectured on war aims, has recently supplied the *Daily Mail* with a translation of certain passages from the address, which leave no further doubt as to the manner in which Germany interprets the "freedom of the seas."

Attention is drawn to this translation in an article contributed to the *Naval and Military Record* by the well-known British naval critic, Hector C. Bywater (for many years a resident of Berlin) who quotes Count Reventlow as follows: "What do we Germans understand by the 'freedom of the seas?' Of course, we do not mean by it that free use of the sea which is the common privilege of all nations in times of peace, the right to the open highways of international trade. That sort of freedom of the sea we had before the war. What we understand today by this doctrine is, that Germany should possess such maritime territories and such naval bases, that at the outbreak of a war we should be able, with our navy ready, reasonably to guarantee ourselves the command of the sea. *We want such a jumping-off place for our navy as would give us a fair chance of dominating the seas and of being free of the seas during a war.* The inalienable possession of the Belgian seaboard is therefore a matter of life and death to us. Our aim must be, not only to keep what our arms have already won on this coast, but sooner or later to extend our seaboard to the south of the Straits of Calais."

So here, at last, the truth is out. The freedom of the seas is to mean freedom for the shipping of all the world until such time as Germany may see fit to declare war, when freedom of the seas is to become a German monopoly. Now, in view of the fact that this question of the seas is to figure so prominently in the terms of peace, whenever these shall come to be discussed, Count Reventlow has certainly done the world good service by thus so unreservedly letting the cat out of the bag.

"It is not the freedom," says Bywater, "but the absolute mastery of the seas that Germany covets, and scarcely a day passes without bringing new proof of this ambition." Thus in a recent issue of the *Deutsche Tageszeitung*, Count Reventlow made a vigorous demand for the full exploitation of the military successes in Italy. Austria-Hungary, he declared, absolutely needed the freedom of the Adriatic for her future development. "We confine ourselves today," he wrote, "to a general statement of our aims—that for the future an active Adriatic policy on the part of Italy shall be made completely impossible, and this, not by paper guarantees, but by real guarantees—that is to say, by appropriate territorial changes on the coast of the Adriatic." Evidently, the Teutonic alliance, if successful, intends to annex all the important strategic points on the Italian side of the Adriatic, and form a chain of bases that would enable its naval forces completely to dominate the Mediterranean. But Count Reventlow would not stop there. He would secure "two central points of power," —the Adriatic and Constantinople with the Dardanelles. Such political, maritime and economic position would stand in the closest combination with the position of the German Empire in the Baltic and on the coast of Flanders. Says Bywater: "Here we have the same cynical avowal of the real aim that is disguised in the 'freedom of the seas' catch-word. With the Baltic a German lake, all the northern waters would be ruled by Germany; with the Flanders coast and the Pas-de-Calais fortified and honeycombed with naval bases, she would sit astride of every trade route converging on England; while from the strongholds of the Adriatic her raiders could issue forth to close the Mediterranean.

It is the command of the seas by the Allies that has saved the world from subjugation by the Teutonic alliance, and when the military and naval power of Germany has been completely disrupted, and the various plenipotentiaries assemble for the peace conference, this question of the "freedom of the seas" must be placed on such a sure basis and secured with such rigid guarantees, that this dream of Reventlow and the Kaiser for whom he speaks, shall be placed beyond any possibility, not merely of attainment but even of attempt.

Our New 16-Inch Naval Gun

ADMIRAL EARLE states that a 16-inch, 50-caliber test gun is practically completed at the Washington Navy Yard, and that it will be proved within the next two months. Twelve of these powerful pieces will form the armament of our new 42,000-ton, 23-knot battleships. He also says that the Bureau has ascertained that the life of the large-caliber gun has been underestimated, the 14-inch, 45-caliber gun having been fired a number of rounds far in excess of that heretofore considered to be practicable. We presume these good results are largely due to our most excellent powder, which, being a pure nitrocellulose powder, has much less erosive action than those containing more or less nitroglycerin. This is a most valuable quality, for it will mean that the new 16-inch, 50-caliber gun above mentioned can be given a velocity considerably greater than would be possible with some other powders, such, for instance, as the English Cordite. We do not know, of course, what this velocity will be; but it is conceivable that (thanks to our powder) we may be able to maintain a muzzle velocity of 2,800 feet per second, and still get a reasonable accuracy-life out of the gun.

Not many people outside of ordnance circles understand what an intimate relation there is between the powder and the gun—that is to say, how greatly the efficiency of any weapon is tied up with the all-round efficiency of the powder. Evidence of this is seen in the fact that the new British 15-inch naval gun is only 40 calibers in length and has a muzzle velocity of not much over 2,300 feet per second. This means that the British 18-inch gun is probably not over 40 calibers in length, and that its muzzle velocity is about the same. If this be so, it is evident that the question of erosion, which has always been a most serious one where Cordite is used, has very largely controlled the design of the gun. High muzzle velocities, other things being equal, mean a high rate of erosion, and low velocities mean relatively light erosion; and if they are getting only about 2,300 foot-seconds out of the new 18-inch gun it would indicate that the British powder still contains a certain percentage of nitroglycerin. Now if, as we hope, the Navy Department intends to secure 2,800 foot-seconds with the new 50-caliber, 16-inch piece, its shells, weighing probably about 2,200 pounds, will have a penetrating power at all ranges at least equal to that of the English 18-inch piece, whose shells must weigh, surely, not less than 3,000 pounds. The trajectory of our gun will be much flatter, and until the developments of the present war, this would have been considered a great advantage.

But due to the extreme ranges at which actions are now being fought, the angle of fall is so steep as to bring extreme-range attack within the category of "high-angle" or "plunging" fire, and, as we showed in an article in our issue of April 7th, 1917, it is not so much the side as the deck of a ship that is vulnerable to such attack. The angle of fall of the lower-velocity shells of the 18-inch gun will, of course, be much steeper than that of the high velocity 16-inch shell of our guns. The danger space of our shells will be greater and more hits will be made; but the 18-inch shells that do hit will strike the lightly-armored deck rather than the heavily-armored side of the enemy—so there you are.

The range of our gun is probably greater, as is also the danger space; on the other hand, there is no question that a 3,000-pound shell falling at an angle of say 25 to 28 degrees, if it hits, would endanger the floatation of a ship more than a 2,200-pound shell striking at an angle of from 18 to 22 degrees, even though the latter carried a higher velocity.

This is an interesting question, and there is much to be said on both sides. Personally we prefer our battery of twelve 50-caliber, 16-inch to one of eight 40-caliber, 18-inch guns.

Unchaining the Books

THERE are libraries in the Old World where you may see how, in the days when the printing press had not yet put an end to the painful labors of the scriptorium, the utility of books was sacrificed to their security. In Florence, the Laurentian Library displays its chained tomes by the hundred. In the English cathedral of Hereford the chapter library has a large case quite filled with these venerable captives.

Nominally the once widespread fashion of chaining books went out in the eighteenth century. Actually, invisible chains continued to fetter a majority of the books in libraries until a much later period, and only in this day and country do we witness a general unshackling.

It may be assumed that the readers of the SCIENTIFIC AMERICAN are a relatively "bookish" class; that they would like to own more books than they can afford to buy; that they appreciate facilities for getting access to the best literature on any particular topic. Probably, however, most of them do not realize what a stupendous wealth of literature is already at their command, thanks to the progress of library service. We recorded certain achievements in this line some time ago (October 2d, 1915, p. 285), but the good work has grown rapidly in the meantime. It is fairly safe to predict that within a few years *any* citizen of this country, living *anywhere* within its bounds, will be able to borrow expeditiously *any* book in *any* public library, except a few rare works that are too precious to go traveling; and even these he will be able to consult by the process of having photo-copies made.

Some of the great steps in the "unchaining" of books realized in the present generation are these:

1. The "open-shelf" system. This means that in a rapidly growing number of public libraries the reader may select his books directly from the shelves; a vast improvement over the plan of making out slips for books which may turn out, not to be just what one wants.

2. Inter-library loans. If your local public library does not contain the book you want, you can probably have it borrowed for you from some library that does.

3. Photo-copying, as already mentioned. This is applicable not only in the case of rare books, but also in cases where the expense of shipping a book would be greater than that of securing photographic copies of the pages in which one is interested.

4. Coöperative cataloging, bibliography, etc. Before a book can be borrowed it must be located. A great deal of immensely valuable work remains to be done in providing information as to the whereabouts of relatively rare works, including complete files of old or local journals, and the like, but a good start has been made in this direction. The Library of Congress has printed cards for about 700,000 books belonging to its own collection and to a few coöperating libraries, and complete sets of these cards may be consulted at 48 depositories, scattered over the country. Many libraries also issue catalogs of their collections in the old-fashioned book form; the most remarkable being that of the Surgeon-General's Office, in Washington, which includes not only the titles of books but also more than a million author and subject entries for articles in medical and other journals. The U. S. Bureau of Education has published a bulletin entitled "Special Collections in Libraries in the United States," from which one may learn which American libraries are strongest in particular fields of knowledge—ranging from psychology to philately, and from alchemy to the history of thugs.

5. Branch libraries, deposits, traveling libraries, and delivery stations. These are various devices for bringing the public library to the people where it is difficult or impossible to bring the people to the public library.

6. Individual service at a distance. This is an extension of the principle involved in No. 5. Certain libraries deliver books in town by wagon or messenger for a trifling fee. More important, however, are the rapidly developing systems of delivery by parcel post to individual addresses in the country. It is unnecessary to enlarge upon what this means to the isolated rural dweller. Coupled with the inter-library loans, it means that any serious student, at least, though he live miles from any city, will eventually be able, without leaving home, to utilize the resources of the greatest libraries in the United States.

To Our Subscribers

IN the present congested condition of our railroads not only are freight and express goods delayed, but even the mails are greatly disturbed. Consequently the SCIENTIFIC AMERICAN is likely to reach you behind schedule time. Do not be alarmed if your copy is several days overdue. If you have renewed your subscription it will reach you safely in due course. Delays are particularly trying in the case of back numbers which, owing to peculiar postal conditions, often fail to arrive until after the current issues have been received.

Naval and Military

Binoculars for the Navy.—The response to the request of the Navy Department for binoculars, telescopes and spyglasses has been most gratifying. By November 23d, about six hundred of these instruments had been voluntarily paid over to the Navy. Letters received by the Department show that hundreds of first-class glasses would be loaned to the Government if the owners were assured of their return at the end of the war. To meet this contingency, the Service has been ordered to place a tag with the name of the owner, on each glass, with a view to keeping records of the same so that they may be returned after the war is over.

Engine-Room Efficiency on a Warship.—The unveiling of a tablet in Canterbury Cathedral to those who lost their lives on the cruiser "Kent" in the Falkland Islands battle, recalls to mind a notable example of engine room efficiency. This cruiser, designed in 1899 to steam at 23 knots, was ordered to overhaul and destroy the German cruiser "Nürnberg," designed six years later to steam 24½ knots—a case of setting a tortoise to catch a hare. The boiler and engine-room staff, however, as stated by Mr. Churchill in the House of Commons, raised the pressure and revolutions of the 16-year-old ship to far above the normal in times of peace, and actually drove the ship at 25 knots, ultimately overhauling the "Nürnberg" and sinking her.

A Weakening of German Resistance in Flanders.—In spite of the great strength with which Germany countered against the recent British drive toward Cambrai, a review of the full field of operations on the British front by Gen. Haig shows that German resistence has been gradually weakening during 1916. He shows that, as the British advance progressed, four-fifths of the total number of divisions engaged on the West front were thrown into the Somme battle—some of them three times. Trench after trench, and strong point after strong point, were wrested from him. The majority of his frequent counter attacks failed completely with heavy loss. Counter attacks that achieved temporary local success, were soon thrown back from the ground they occupied.

Alsace-Lorraine Dominates the War.—Germany will fight harder to retain Alsace-Lorraine than any other territory in the present war; for Alsace-Lorraine, in the last analysis, is the foundation of the material side of Prussian militarism. It is upon the basis of her possession of this district, with its enormous mineral wealth, that Germany has built up her industrial imperialism, as the following facts will show. Out of 28,600,000 tons of iron ore, which Germany extracted from her mines in 1913, 21,000,000 tons came from Lorraine. Out of the 2,800,000,000 tons of iron ore deposit in Germany it is admitted by the German engineers that Lorraine alone contains 2,100,000,000. For the last forty years, the mineral wealth of Lorraine has been the principal source from which German metallurgy has gathered its raw materials and German militarism its munitions.

Value of the Belgian Coast.—The Germans understood full well the strategic value of that portion of the Belgian coast which they now hold. Thus the *Vossische Zeitung* writes: "A base in Flanders would enable England to annihilate with her air squadrons the whole of our industrial basis, and to drive Germany completely from the seas. German industry would be at her mercy. We must hold our positions between the sea and the Lys, or we shall lose the war entirely. The fate of Germany is now being decided in Flanders." When the British push back the German line in Flanders, no doubt the question will come up of joint naval and military operations for seizing the German bases on this coast. Evidence is not wanting that German confidence in their ability to hold this district, has been shaken. Orders to the troops in Flanders, which have been gathered from German officers, show that because of shrinking manpower and the threatened shortage of munitions, commanders have been urged to maintain a defensive attitude and to refuse, as far as possible, to be drawn into offensive movements that are costly in shells and men.

Repairs to the "Vaterland."—Commander E. P. Jessup, U. S. N., has made public some very interesting facts regarding the repairs to the "Vaterland," now the "Leviathan." Her engines are of the Parsons type of turbine, and consist of four ahead and four astern turbines on four shafts. The ahead engines were in good condition, but all the astern engines were damaged; it is a curious fact that this damage was due to faulty operation and not to malicious intent. Extensive cracks were found in the casing of the starboard high-pressure backing turbine, and certain written matter found on board shows that these engines had not been used on the last run, the trip having been made on three propellers and at reduced speed. One crack extended a distance of about eight feet around the circumference of the steam belt in the lower casing. In the repairs, the impulse blading was cut off entirely, and while this reduced the economy it did not reduce the backing power to any extent. Only a few minor attempts at the disabling of the ship were discovered.

Science

Proposed Change in Swiss Time.—A movement is on foot in Switzerland to adopt the 24-hour clock for official purposes, abolishing "A. M." and "P. M." This plan is already in use in several other European countries.

Japanese Medical Corps in Roumania. According to *Science*, a Japanese medical corps of 100 men has gone to Roumania to help control the epidemic of typhus fever in that country. The headquarters of the corps will be at Jassy.

A National Seed-Testing Station for England and Wales has just been opened in London, under the direction of the Food Production Department of the Board of Agriculture. Under an order recently issued by the Ministry of Food, the sale of the more important seeds will hereafter be closely controlled by the government, and the necessary tests in this connection, as well as tests made for the public at large, will be carried out at the new station.

New Coalfields in Spitsbergen.—The exploitation of Spitsbergen's coal deposits has continued during the war. A new company has been formed in Sweden and its plans, as described in a recent consular report from Stockholm, contemplate an eventual annual output of 1,000,000 tons. It is proposed to build a railway 50 miles long from the company's property, Sveagruvorna, to the western coast, where a harbor can be made from which coal can be shipped eight months in the year, instead of two as at present.

Careless Preparation of Crude Drugs.—According to the Bureau of Chemistry there is need for much greater care than is now generally exercised in the collection and preparation of native crude drugs, to exclude earth, trash and foreign plant matter. Specimens examined by the Bureau show pennyroyal containing 20 per cent of sand, unicorn root containing 15 per cent of earth, and pipsissiwa "leaves" consisting almost entirely of stems. There are also many cases of substitution of one species for another; *e. g.*, non-official species of aconite, containing no aconitine, for true medical aconite.

The Island of Ascension, which was described by Sir Joseph Hooker as a "scorched mass of volcanic matter, in part resembling bottle-glass and in part coke and cinders," has recently undergone a sudden transformation, owing to the appearance of a luxuriant mantle of grass. According to a *Kew Bulletin* the grass is *Enneapogon mollis;* it has never been reported from the island before, but is a native of tropical Africa. Whether the seeds were borne to the island by birds or the wind is uncertain, but their sudden germination appears to have been due to the occurrence of copious showers—a rare event in Ascension.

The International Health Board of the Rockefeller Foundation continues to devote its efforts chiefly to combating the hookworm. Systematic efforts toward a control of hookworm disease have now been set on foot in eight southern states in this country and in 15 foreign countries in tropical and subtropical latitudes. According to the last annual report, new fields occupied in 1916 included Salvador, Brazil, Ceylon and Siam, and arrangements were made for work in the Fiji Islands, Papua and Queensland. Preliminary infection surveys were made in British Honduras, Barbados and the Yangtse Valley, China. The board is also carrying on some important experiments in malaria control.

Patent Medicines in the Philippines.—According to a law passed early in 1917, and interpretations thereof recently promulgated by the Philippine Health Service, all simple and pharmaceutical preparations, except those used exclusively for cosmetic purposes, must be labeled on the bottle or immediate container with a quantitative and qualitative formula in English. The formula must also appear in any advertised matter distributed or published, and the use of statements that are false or misleading in any respect may result in the exclusion of the preparation so advertised. Before any patent or proprietary medicine may be offered for sale it must be analyzed and favorably reported on by the Bureau of Science.

Volcanic Deposits after Fourteen Years.—Writing in the *West Indian Bulletin,* Mr. H. A. Tempany gives the results of physical, chemical and biological studies of the ash deposits in the Carib country of St. Vincent, laid down at the time of the eruptions of the Soufriere in 1902 and 1903. The deposits, which range in depth from fourteen to eighteen inches, consist of coarse sandy types. They show small contents of organic carbon and nitrogen, are extremely deficient in calcium carbonate, and contain moderate amounts of available phosphoric acid and potash. They give evidence of a moderate activity of putrefactive bacteria. Nitrogen-fixing organisms of the Azotobacter type are present. The soil possesses appreciable nitrogen-fixing and ammonifying power, but no nitrifying power. Considerable progress has been made in the conversion of these sterile ash deposits into fertile soil.

Electricity

A Current Limiter.—There has recently been developed a protective device known as a current limiter, the function of which is to open the circuit instantly on heavy overloads and reclose the circuit as soon as the overload is removed. In the usual installation an overload results in the blowing of the fuses, which means a considerable loss of time and a considerable expense in renewing the fuses. The current limiter is particularly applicable to electric drills, since it shuts off the current at the first sign of an overload and thus prevents drill breakages and saves the motor from overheating.

Lighting Large Rooms from Pedestal Fixtures.—In a recent issue of *Electrical World* the novel electric lighting of the South Shore Country Club at Chicago, is covered in detail. It appears that there are two garden foyers which form the terminus of the promenade, each of which measures 36 feet by 72 feet. The high arched ceilings are tinted a faint sky blue. The light is all supplied from a seven-foot pedestal which contains two 500-watt gas-filled tungsten lamps in silvered mirror reflectors. Harsh shadows and glare are avoided with this indirect system of lighting, and every detail of the decorations has been clearly brought out.

Some Electrical Properties of Silver Sulfide.—This substance may be prepared in the form of short wires or thin strips like metal. The wire, which must be drawn hot, has been found to conduct electricity like a metal of high specific resistance and has a practically zero temperature coefficient. The strip of sulfide, rolled at room temperature, has a large negative temperature coefficient and shows both metallic and electrolytic conduction at the same time. It has a volt-ampere curve characteristic of a pyro-electric conductor. The resistance of these strips has been examined with both alternating and direct current with the result that the alternating-current resistance was nearly always found to be higher than that with the direct current, and the passage of a small alternating current of a frequency as low as 60 cycles increased temporarily the resistance of the sulfide while a small direct current produced the opposite effect. Scientific Paper No. 310 of the Bureau of Standards, discusses this investigation.

Converting Electricity Into Steam.—In a recent issue of *Engineering,* an account is given of a new type of electrical steam generator invented by Colonel Revel, an engineer in the Italian army. The essential idea in the apparatus is the direct conversion of electric energy into heat by making use of the resistance of the water to be evaporated. Alternating circuits of 200 to 3,600 volts can be applied, and this apparatus is stated to be automatic and to require no regulation. Lack of feed water merely diminishes the production of steam until the supply of water is renewed. The efficiency is claimed to be 97-98 per cent. The Revel apparatus is constructed to work at pressures of 14 atmospheres, and can be connected up at any time to the steam pipes of an ordinary boiler. In this way temporary use can be made of hydro-electric supplies, and their utility can be judged by the fact they were often used even before the war when the price of coal in Italy did not exceed $8.00 a ton. An illustration is shown of an installation of eight generators taking three-phase current at 6,000 volts, and each developing 900-1,000 kg. of steam per hour. The production of steam varies according to the area of the electrodes immersed. The sediment collecting at the base of the apparatus from water containing calcareous material can be released without interrupting the process.

Hand-Driven Generators for Pocket Lamps.—A recent issue of the *Elektrotechnische Zeitschrift* gives some fuller particulars of a new type of pocket torch being developed in Germany and Austria, in which the lamp is supplied with current from a small hand-driven magneto. The shortage of certain material is putting a limit to the manufacture of dry cells and small accumulators for public use, and this is no doubt responsible for the tendency to utilize a hand-driven source of current for pocket lamps of various kinds. Lamps of this kind may be more expensive than the ordinary variety, but they do not require refills or recharging. One of the types described is due to K. v. Dreger of Budapest, and depends on the release of energy from a series of springs put into tension by the pressure of the thumb on a lever. The whole arrangement weighs about one pound, and is so contained that the release of the spring supplies electric energy to keep the lamp alight for three minutes. In order to secure a light for ten minutes a heavier machine, weighing about five pounds, and requiring to be wound up with both hands, has been designed. In these lamps the armature is the rotating part, but in another variety, due to O. Pletscher, the field revolves in ball bearings round a T-shaped armature. This lamp is stated to weigh only half a pound. A somewhat larger apparatus, weighing about three pounds, is designed to work as a light for cycles. The above types appear to be based on the release of spring energy, which, having been wound up, supplies current for a limited period on release without further effort being necessary.

Copyright Underwood and Underwood

Tank hauling back to British lines a German gun, captured in Cambrai drive. Note the camouflage

One of the captured heavy German field guns, towed home by its captor

British and French Tanks

AFTER more than a year of trial on the western front, the tank seems to have won for itself a permanent place among the major offensive weapons of warfare as it is carried on today. Undoubtedly, its prestige has been increased by the dramatic way in which it breached the Hindenburg line and opened a gap which was subsequently enlarged to the deep Cambrai salient.

We have already, in these columns, drawn attention to the fact that the tank is essentially a weapon of the offense and not of the defense. Herein probably will be found the reason why the Germans have made no use of them; for, since the Battle of the Somme, Germany has been strictly on the defensive in France and Flanders.

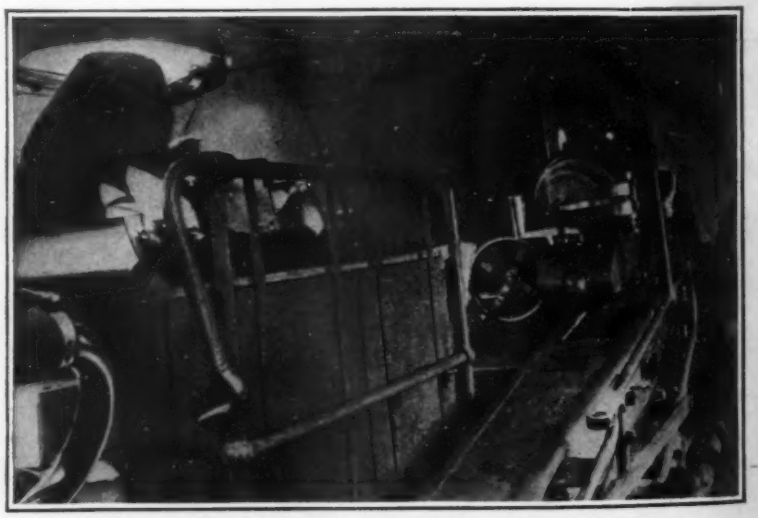
Just what will be the future status of this weapon it is difficult to predict. The British appear to be satisfied with its work; and the French have shown their appreciation by building a considerable number which have been used in their recent more important offensives. Germany, true to her usual policy of depreciation of what the other fellow is doing, professes to hold them in contempt.

The British tanks are of two types—male and female—The male, is armed with two six-pounder, rapid-fire Hotchkiss guns and four Lewis guns. The female carries six Lewis guns. Each type weighs 30 tons and each is manned by an officer and seven men. The belts run entirely around the machine, and the great length of belt in contact with the ground gives very large tractive effect—the upwardly sloping front enabling the tank to bite against the sloping sides of shell craters, river banks and entrenchments and lift itself over. The plating is of quarter-inch steel of special composition and great power of resistance against rifle, machine-gun and shrapnel fire. It is powerless, of course, against a direct hit by shell fire, or the larger fragments of exploding shells. Both types are driven by a motor of the Knight Silent type of 105 horse-power.

The French tanks differ very materially in design from the British. The belt follows the conventional lines of the ordinary road or farm tractor; and it is therefore better protected against shell attack, and the trucks against which the belt bears being spring-supported, it should be less liable to rupture. The tractive effect, on account of the shorter length of belt in contact with the ground, is not so great as that of the English tank; and probably a French machine would be stuck in a hole out of which the British tank would be able to lift itself. The French machines carry on the roof a camouflage canvas, which can be unrolled to conceal the tank when it is at rest.

We publish what is probably the clearest interior view of a tank that has ever been shown. It is interesting to note that the French have utilized one of their famous 75's, and in doing so have apparently merely removed the wheels and have mounted the gun with its trail bodily within the car.

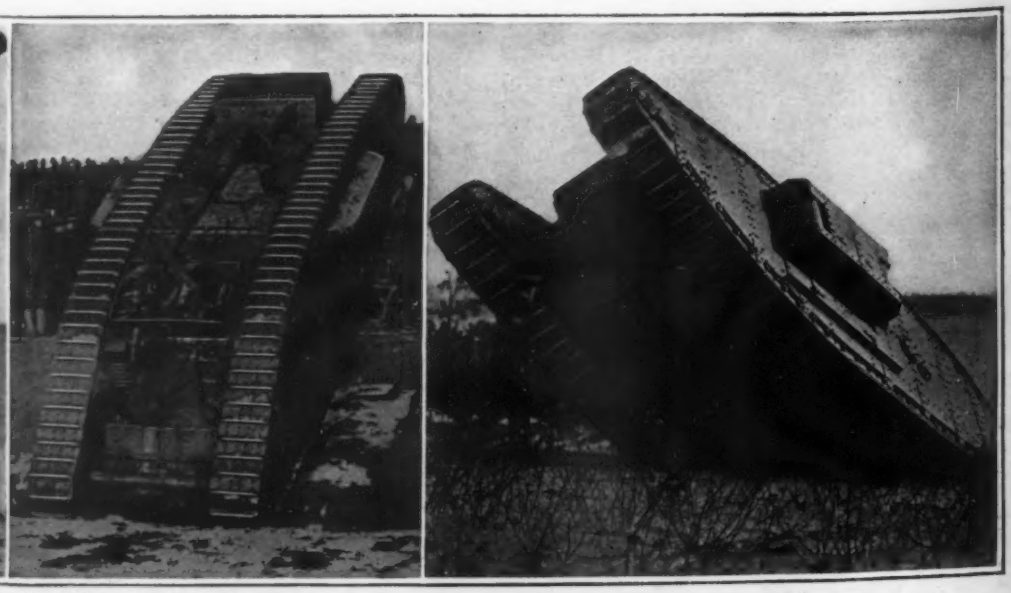
French tank, camouflaged. Note canvas on roof, which is let down to conceal tank when at rest



Interior of French tank, showing breech and trail of French 75 mm. field gun

Copyright International Film Service

French tank with one 75 mm. gun and four machine guns



Copyright Underwood and Underwood

Two views of British tank "Britannia" giving demonstration at Camp Upton

Uncle Sam's Ground Schools for Flyers

Giving Observers Practical Experience in "Spotting" on a Miniature Battlefield

By C. H. Claudy

THE War Department says, "It must be remembered that the flying officer is not an 'aerial chauffeur' or 'exhibition flyer.' He has been more correctly defined as a twentieth century cavalry officer mounted on Pegasus."

A cavalry officer, whether mounted on a Pegasus of cloth and gasoline engine, his regular mount, or an army mule, has got to know considerable about military science if he is going to be an asset and not a liability.

Hence, it is that the "ground school" for candidates for aviation commissions are becoming more and more important in the eyes of military authorities. A brigadier-general in the British aviation corps has said: "The longer the war continues the more we realize the vital necessity of the work done in ground schools and the need for learning more and more subjects which previously were not taken up until the would-be flyer stepped into his machine."

With the urgent necessity to supply pilots and observers for the 22,000 airplanes the United States is now building or about to build (no information as to the actual state of this building program is being given out by the Aviation Service of the Signal Corps) the establishment of "ground schools" where young men who can pass the necessary physical and mental tests are instructed in the thousand-and-one things they need to know before they ever set foot in a machine, became immediately essential.

The development was typically American. On the first of last May General Squiers, Chief Signal Officer, commandeered the services of Prof. (now Lieutenant Colonel) Hiram Bingham, who until then was teaching at Yale University. Intensely interested in aviation, Prof. Bingham had made many flights and studied the subject from all angles. He did this, believing aviation would play the deciding part in the war, and wanting to get into it, even though age debarred him from active service. When the need came for an instructor who could instruct, Prof. Bingham was ready and waiting.

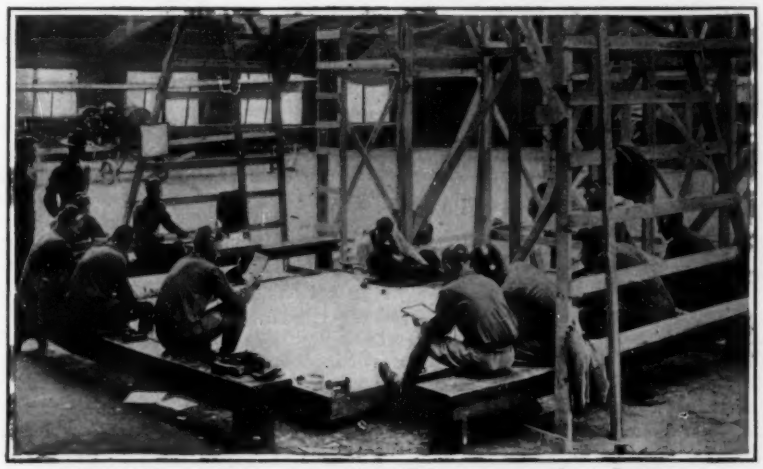
With a corps of assistants he made a rapid but thorough inspection of the military aeronautics schools of the Royal Flying Corps at Toronto, sat up nights planning, consulting and thinking, and within ten days started six American Ground Schools. Two more have since been added, and all are doing work about which the general public knows little, but which is vital in the aeronautic campaign for "putting out Germany's eyes."

The American schools are located at the following colleges: University of California, Cornell, Georgia School of Technology, Princeton University, University of Illinois, Massachusetts Institute of Technology, Ohio State University, and University of Texas. Although they have taken over a large part of the technical apparatus and some of the instructors of the universities on whose grounds they are situated, they are in no sense a part of the university or of the ordinary university course. They are Army posts administered and supplied by the Schools Section, Air Division, United States Signal Corps.

It is well that it is so. No University student would submit to the knowledge-cramming process which students at the ground schools must stand. Within eight weeks these young men have to assimilate a variety and amount of information which would be staggering if cataloged. There is no time wasted about it, either. Students begin their day at 5.30 A. M., and tumble into bed at 9.30—and those who have seen these schools say that there is no need of having a guard go around to see if lights are out and the men in bed. The difficulty is to keep them awake until taps!

The day's program—with minor differences between schools and between days when certain contingencies arise, runs like this:

Reveille, first call 5.30, Assembly, 5.45, Calisthenics until 6.00, Mess, first call, 6.15, Assembly, 6.20, Inspection, first call, 7.20, Telegraphy, 7.30, School, first call, 7.55, Assembly, 8.00, School, first call, 8.55, Assembly, 9.00, School, first call, 9.55, Assembly, 10.00, School, first call, 10.55, Assembly, 11.00, Recall, 12.00, Mess, first call, 12.10, Assembly, 12.15, School, first call, 1.55, Assembly, 2.00, School, first call, 2.55, Assembly, 3.00, Drill, first call, 4.00, Assembly, 4.05, Recall, 5.00, Retreat, first call, 6.05, Assembly, 6.10, Mess call, 6.15, School call, 7.30, Tattoo, 8.30, and Taps, 9.30.



Artillery officers taking wireless "spots" from aeronautic students on a gallery above

Only a man of good physique and perfect health can stand a program like that. Only a man with brains can make use of it. Young men are desired—men from nineteen to thirty generally, "although in exceptional cases", to quote the official announcement, "older men of pronounced athletic attainments who have spent most of their lives out of doors, in the saddle, ranching, playing polo, mountain climbing, or in actual flying, may be accepted if they can satisfy the examining board of their physical fitness."

Physical fitness means perfect nerves, perfect eyes, perfect hearing, physical strength, perfect health. Light men are preferred to heavy ones, and slight builds have as good chance as stocky, providing the slightness does not mean thinness.

No young man should shy away from the service because he fears his physical attainments are not up to standard. Trapeze performers, boxers, jiu-jitsu experts or other athletes who have quick nervous reaction and strength are welcome. But so are any young men with good bodies and good brains. The ground schools will do the teaching if the youth of the country will give them the material.

Having the men, the course proceeds on Colonel Bingham's theory that only a chap who can stand cramming can make a good aviator—and they proceed to cram him. The first three weeks of the course or "junior wing" takes up military study. Infantry drill in the school of the soldier, the school of the company, physical training, and first aid, are well inculcated. There are lectures on military courtesy, organization and administration of the United States and modern European armies, Army paper work, military hygiene, etc. The junior wing receives daily instruction in the use of a machine gun and in wireless telegraphy, and in between are athletics, drills, more lectures and again drill, drill drill.

In the fourth week the "senior wing" subjects are taken up. Theory of flight, engines, telegraphic signalling, the use of aerial instruments, (barometer, compass, speed indicators, inclinometers, barograph, etc.), come first. Then classes in airplane rigging, repair of planes and engines, construction, types of airplanes are taken up in the fifth week in addition to the courses in telegraphic signalling, engine work, laboratory work, machine gunnery, etc., which go on all the time. Later come lectures on radio work, air fighting, map reading, meteorology, bombs and aerial photography.

The instruction, of course, is of the most practical kind. The education is intensive to the *n*th degree. What the ground schools try to do is turn out men who can be made into flyers, who will be worth something—not graduates in aerology who can merely pass a brilliant theoretical examination.

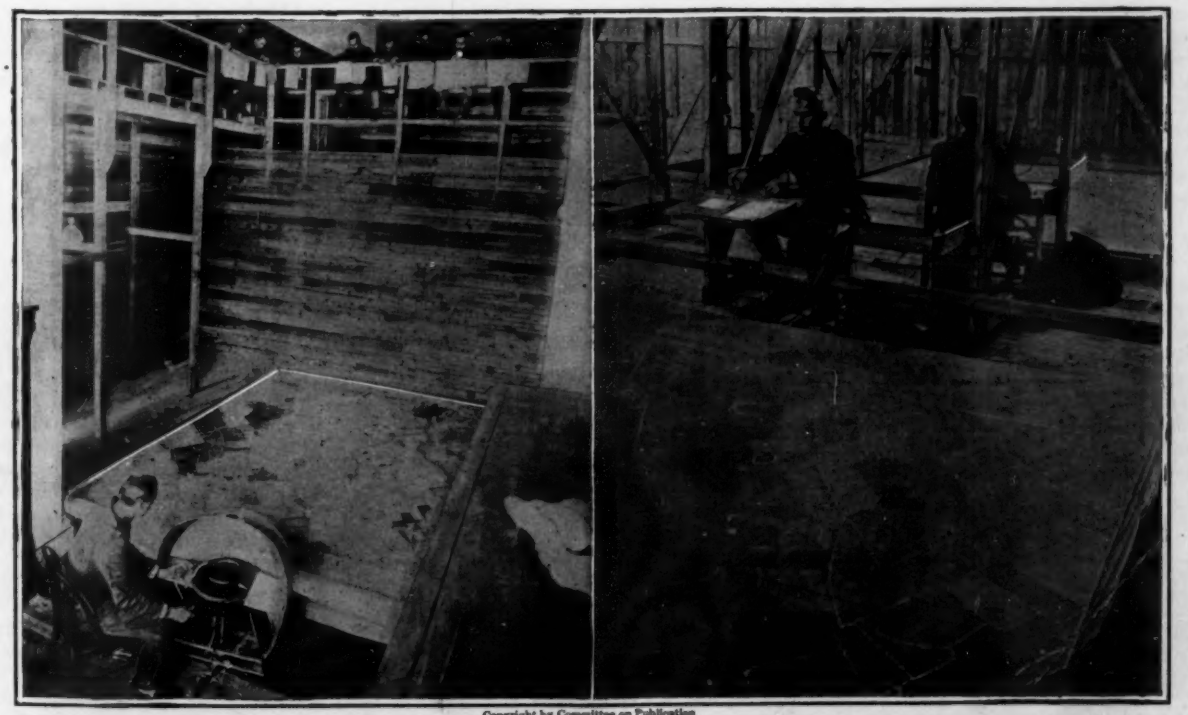
An instance will show how practical the instruction is. In a ground school "somewhere in America" a visitor—supposing a visitor could gain admission—would find several dozen young fellows intently studying a miniature battlefield. This "battlefield" might be called a map, were it not for its huge size, and the fact that flashes—imitations of exploding shells, take place upon its surface at disconcerting intervals and unknown locations. A structure of scaffolding surrounds the "battlefield," and on top is another corps of young men, intently watching and locating these flashes as they occur.

The young men at the base of the structure are impersonating artillery officers. Those overhead are pilots and observers, supposed to be in an airplane. And to make the game real, there is real wireless, and the men above signal to those below in the cryptic code of the map squares, to "locate" the hits and correct the "range" of the "guns."

"W— 28 E-6-8" buzzes the wireless. Another flash, a quick survey and "E—7-A 11" comes the signal. At first the "pilots" are slow, wavering, undecided—later they become certain and quick, and the buzz of the wireless comes almost instantly after the flash.

No theory here. Men are being taught as well as they can be without actually being in a place high in the clouds above a real battlefield, what it is like to see the flash of a gun or the

(Concluded on page 77)



Copyright by Committee on Publication

Testing the "spotting" ability of airplane observers by making flashes of light on a battlefield reproduced as it would appear from an elevation of 6,000 feet

Receiving a message from an observer overhead who endeavors to locate an enemy battery by light flashes on the miniature battlefield

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Where Shall We Get Sulfur?

THE air is full of troubles and one of the latest worries is oil of vitriol or sulfuric acid. It is needed to make munitions, fertilizer, to refine petroleum and for gasoline and lubricating oil; and it touches a great part of the objects in daily use at one point or another in manufacture. It is said that the industrial efficiency of a country may be gaged by its production of sulfuric acid. Mr. Henry Howard of the National Defense Council lately told of the situation in *Metallurgical and Chemical Engineering* and he speaks with authority, being one of our leading manufacturers of the product.

Until the beginning of the war we had enough and to spare. By April, 1915, the surplus had been absorbed and prices began to soar. The vast amount needed to make explosives was the principal reason for this. To make it the first step is to burn sulfur or to roast sulfurous ores of metals. Now we have plenty of sulfurous copper ores, but the transportation costs of the ores or of sulfuric acid from the western copper country would eat up its value. So we can't get sulfuric acid from Montana and Arizona. There are iron pyrites mines in the United States but most of them are small and it takes a long time to open up big mines. There are large quantities of sulfur in Louisiana and Texas, but nearly the entire output of these great works is taken up in making sulphite pulp. Their capacity is limited.

The Gulf sulfur producers have been patriotic and placed all their reserves on the market at practically before-the-war prices, but even this makes the acid costly and the reserves are about at an end. They cannot increase their capacity now. The equipment, which is very elaborate, can only be purchased for delivery way off in the future.

The usual method has been to get iron pyrites from Spain brought here as return cargoes in steamers. This was roasted at the tidewater acid works and the remaining sulfur-free ore sold to blast furnaces. That is the economical method. Cargo rates were low from Europe to America. Now some pyrites comes from Spain, but not enough.

In 1916, 6,250,000 tons of 50 degree Be. acid was produced in the United States. Requirements for 1917 are 8,000,000 tons. The production will be inadequate to meet the demand for the remainder of the war and it looks as though by next spring a preference committee will have to determine what industries may receive the acid and which ones may not.

The Potash Cry

EVERYBODY knows there is plenty of potash in the earth and the price tells us there is next to none to be had.

Before we go any further let's see what this "K_2O basis" is that they always bring in when they talk of potash. K_2O is potassium oxide that can be produced, but not kept, save in sealed tubes. There's water in the air all the time, more water than music, and one molecule or unit of water will combine with one molecule or unit of K_2O to make two of caustic potash. It means the element in a soluble combination and it offers a basis for figuring. The amount of K_2O in a ton of potash salts varies according to the chloride, sulfate, carbonate, etc., contained in it. Selah.

Now let us consider a new source, known as "greensand" and which is, green sand. The deposit begins on the New Jersey coast at New York Bay and extends in a strip from ten to twenty miles wide past Trenton, Camden, Wilmington, Delaware, through Virginia at Richmond and into North Carolina. The body is known as glauconite which is a double silicate of potassium and iron. The average content is three to eight per cent of potash, the richest deposits being in New Jersey. There's enough potash in those sands to supply the whole world for a long time.

The trick that has been turned is one that we have been wanting. This raw material is a compound silicate —is a kind of glass or sand or rock—and insoluble. The only way to tear it apart, chemically, seemed to be to go at it with the electric arc and that requires too much power for economical production. That is why the great deposits of feldspar in this country have not rescued us from the potash famine. It was an electrochemical process and electricity is expensive in the great big currents required.

Mr. H. W. Charlton is a Canadian chemist and in working with ground feldspar he found that he could get the potash out without the aid of electric generators. Then came Mr. T. C. Meadows, a Tennessee chemist, but long known in New York, and he asked the illuminating question, "Why go to the mountains for feldspar when we have the green sand right at hand at tidewater, ready to be taken up by steam shovels and all finely divided?" The results are so promising that the priority board has under consideration the release of steel to build a 20-ton plant.

The patented process is simple: put green sand into a boiler with water and an amount of lime to offset the potash in the sand. Heat it up to a pressure of 225 pounds. Within two to three hours the lime will have taken the place of the potash in the sand and the potash will be in solution. The solution is drawn off and boiled down in multiple effect evaporators to a solution of caustic potash of any desired strength. If chloride of potash is wanted, put calcium chloride into the boiler. If the carbonate is wanted, run carbonic acid gas through the solution.

The residue is a double silicate of iron and lime. This has the properties of cement. Mixed with sand and steam hardened, it becomes almost as hard as granite. It absorbs less than five per cent of water, says Mr. Meadows. It is available for sewer pipe, roofing tile, as a substitute for terra cotta and it makes wonderfully hard brick. If the sand is roasted before treatment the brick are light brown, if not roasted they are light green.

So there you are. It isn't going yet, nothing is a big success until it is going big and the goodness knows there are troubles a-plenty in doing the simplest things on a large scale by a new process. But if it does work well and they can supply say, New York city with its regular requirements of brick, they figure that they can produce two-thirds of the normal requirement of potash of the United States. Throw in Philadelphia, Wilmington and Baltimore and—but it is dangerous to throw big cities around that way. And the brick business is an established industry; we mustn't forget that. The brick output is said to be 25,000 to a ton of potash.

Putting On Weight

DR. GRAHAM LUSK, professor of physiological chemistry at the Cornell University Medical School, and one of the leading authorities in the country on nutrition, delivered an address at the request of the U. S. Food Administration on "Food in War Time" which was printed in *Scientific Monthly*. We shall extract a few notes from it but before doing so we should like to say that very roughly and inexactly, 100 large calories represent the heat required to boil a quart of water in cold weather. This is one of those definitions that are better not tested by experiment, for if you were to take an alcohol lamp to boil the water you would need more alcohol than that which produces 100 calories in combustion, because with an ordinary kettle and lamp you would waste a great deal of heat. One hundred calories represents the heat used, not the heat produced.

If a healthy man weighing 156 pounds is put into the box of a calorimeter before breakfast and allowed to lie comfortably on a bed, completely relaxed, he produces 70 calories an hour. He does this by the combustion, the slow burning, in other words, chiefly of carbohydrates and fats that he has eaten; burning them to carbonic acid, gas and water. This represents the energy needed to maintain the beating of his heart, his breathing apparatus, his body temperature and to keep in a living state his numerous tissues. Every other movement that he makes takes more energy, and means that he must produce more calories. If he eats nothing he keeps on living for a while, but he uses up the fat stored in his body. Fuel he must have.

As soon as he begins to work the calories may be said to fly. A woman sewing with a needle for eight hours required 1,800 calories a day. A washerwoman, scrubbing hard, used 3,400. Two tailors, men, required 2,400 and 2,500. Farmers average about 3,500. Two men sawing wood needed 5,000 and 5,400 respectively and lumber jacks, six-day bicycle racers and men engaged in long mountain ascents reach as high as 10,000 calories a day. The harder you work or the bigger or fatter or heavier you are, the more calories you use up because there is so much more to carry.

Bread, potatoes, rice, corn and fats are great fuel foods, because in them this fuel quality predominates. For rebuilding tissue we need proteins and although the foods mentioned carry them in greater or less degree, they predominate in meat, fish and beans. The writer of this is no spring chicken in years and he certainly is fat; he is also fond of good living and does not want to reform. Nevertheless he is constrained to admit, as Professor Lusk proves, that we do not need but a mere fraction of the meat we eat. There seems to be no convenient way of measuring protein values as we proceed at meat, but it seems also to be understood that most Americans take more than is good for them. We get enough any way if we have enough to eat. If we feel worried about the shortage of our protein rations a plate of beans contains enough to carry us through until we worry again. This is said with deep regret (not by Dr. Lusk) but it is true. A man lived for 300 days on potatoes and oleomargarine, worked hard during the last three months of the experiment and was well. How he enjoyed himself is not recorded. The high protein and almost carbohydrate-free diet of "Eat and Grow Thin" is referred to as directions for achieving utter misery. The right plan, according to Dr. Lusk, is to not eat that little extra portion. If living your life requires 2,500 calories a day and you take 2,580, the extra 80 would be provided by one-third of an ounce of butter, or an ounce of bread or half a glass of milk. It seems but a little, nevertheless in one year it amounts to nine pounds and in ten years, 90 pounds.

On the other hand, if you are fighting in France you need what you want when you want it and, God bless you, you should have it!

Chemists Answer Nation's Call

IT took seventy-five years for Germany to build up her chemical industries to their present high plane. In three years American chemists have done as much as Germany has accomplished during three-quarters of a century. The war has been the vivifying touch. We have had to do without German chemicals formerly considered indispensable, and we have discovered that they can be produced here or substitutes found. The past three years will affect the chemical industry of the country for a century to come.

This story, while hinted at, has not yet been told. It is accordingly interesting as well as pertinent to particularize. Prior to the war 74 per cent of the dyes used in this country came from Germany; the rest were made here by German permission. When German imports were cut off American chemists got busy, and now American-made dyes meet nearly all trade requirements. In 1914 there were five concerns making aniline dyestuffs in this country, and a mere handful of manufacturers of the crudes and intermediates. Today there are over ninety of the latter and over eighty of the former; and the list is still growing. Practically a full line of direct acid, basic and chrome colors are now being made in the United States, including all the fundamental needs of the textile industry, the varnish and wood staining trade, and many other important lines. American colors today, compare well with the best imported colors, alike as regards brilliancy, fastness to washing and light, and general wearing qualities.

Nor has our activity stopped with dyestuffs. All unprepared, the chemists of this country have been called upon to produce in enormous quantities munitions for belligerents. They have been held to very exacting standards and in every case they have met the issue successfully.

Besides what might be termed conventional munitions the skill of our chemists has been of great help in the development of new explosives, gases and liquid fires. The tear gas which has created such havoc along the German lines was developed by a professor of chemistry in Johns Hopkins University. The trench gases, of which the bases are chlorine and bromine, are made in this country. There are ingenious gas bombs for illuminating battlefileds at night which are likewise of recent American origin. Our American chemists have also had a great deal to do recently with the making of explosives and hand grenades.

Since the declaration of War against Germany our chemists have been asked by manufacturers to find substitutes for many metals not now available. Many new alloys have therefore come into use of which we probably would never have heard had it not been for the necessities of warfare. Further, nitric acid, a first prerequisite of war and agriculture, is usually obtained by subjecting nitrate of soda to certain chemical processes. This raw material exists in large beds in Chile. Germany was far-seeing enough to realize that in war she might be cut off from that supply, and therefore she developed processes for obtaining nitrogen from the atmosphere. At the present time we, too, are suffering from a deficit of Chilean nitrates; and American chemists are producing in the south a limited amount of atmospheric acid, with every indication that the output will before long nearly equal the demand.

Steel figures much in the operations of modern warfare, therefore American chemists have been obliged to devise substances which will impart new qualities to it. They have met the issue and produced thousands of tons of fundamental steel and iron alloys—steels of every variety of roughness, hardness and elasticity. They have also met the call for purified copper by the millions of pounds, for aluminum for airships and motor cars, and for the abrasives on which so much depends.

(Concluded on page 78)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Synchronous Flashing of Fireflies

To the Editor of the SCIENTIFIC AMERICAN:

Regarding the remarks on this subject under the head of "Science" in your issue of November 17th., last, the following observations may be of interest to some of your readers.

In the town of Cotabato, Island of Mindanao, P. I., a few years ago, there were two trees about the size of apple trees, and perhaps a hundred feet apart, and every evening these were filled with fireflies which flashed in synchronism, first one tree lighting up and then the other. There must have been several thousand insects in each tree, yet the synchronism was so perfect that rarely or never did a single firefly flash at the wrong time.

To the best of my recollection the illuminated period lasted about two or three seconds and the dark period perhaps twice that long. I can positively vouch for the accuracy of the foregoing for it seemed so strange, and produced so beautiful an effect that I thought it one of the most remarkable things in the Philippines, and it made a deep impression on me.

JOHN V. PURSSELL.

Washington, D. C.

Facilitating the Transportation of Coal

To the Editor of the SCIENTIFIC AMERICAN:

The present method of shipping coal in regular coal cars and consuming a great deal of time in switching the cars to various points of a city where the cars stand on a siding for many days before being returned to the mines, causes this method to be very inefficient.

The system I wish to suggest for your consideration would be adapted to cities or other points of destination that could use at least several carloads of coal at one shipment to be discharged at one place.

The plan would be to use an entire train of flat cars having hinged side boards. The entire train, or several cars, to be unloaded onto a previously prepared board floor or any place made convenient for the loading of wagons or trucks for delivery to various points throughout the city. The prepared floor having a length equal to the length of the number of cars to be unloaded.

The flat cars to be unloaded by a train unloading plow the same as shown in one of your recent issues, the coal being plowed off the cars onto the ground or board floor at either side, or both sides of the track. A train of 12 cars of gravel can be unloaded in from ten to thirty minutes by this method. There is no reason why coal cannot be handled in the same way.

In order to save the shoveling by hand of the coal into the trucks and wagons, they could be loaded automatically by being placed in position at the side of the flat cars. There would be very little expense for a city to prepare a place at the side of the railroad for discharging coal in this way that is located at a convenient point for a number of dealers and consumers of coal.

This method would make it possible to have the coal train on the move to and from the mines, or being loaded at the mines probably 97 per cent of the time, whereas under the present system the greater portion of the time is spent on the siding. The side boards being hinged at the bottom and arranged to spread outwardly at the top when released makes it possible to load the cars to any capacity desired.

This method is well understood by construction engineers for handling of gravel, and it seems to me it will be a great help to relieve congestion of the railroads and to aid in solving the coal problem.

Cleveland, Ohio. JOHN A. MATHES.

The Aerial Torpedo

To the Editor of the SCIENTIFIC AMERICAN:

In the December 15th issue of the SCIENTIFIC AMERICAN, I was very much interested in the letter to you, written by Allen M. Culver, Los Angeles, Cal., regarding substituting the airplane for the large gun.

It occurred to me that an aerial torpedo or a flying shell might be a modification of this idea and worked out satisfactorily. Doubtless it would be impracticable to start the aerial apparatus working immediately the shell leaves the gun. If the shell "takes wings" so to speak and has a propeller, which would be necessary, they would have to be enclosed so that there would be no resistance to the air.

The internal mechanism should be arranged so that the wings and propeller open up and take effect after the force of the shell is spent. Perhaps a mechanical rudder would also be necessary to maintain properly the equilibrium of the shell.

The main purpose of this would be not to replace heavy artillery but to increase the distance for possible effectiveness.

IRVING F. TOOMBS.

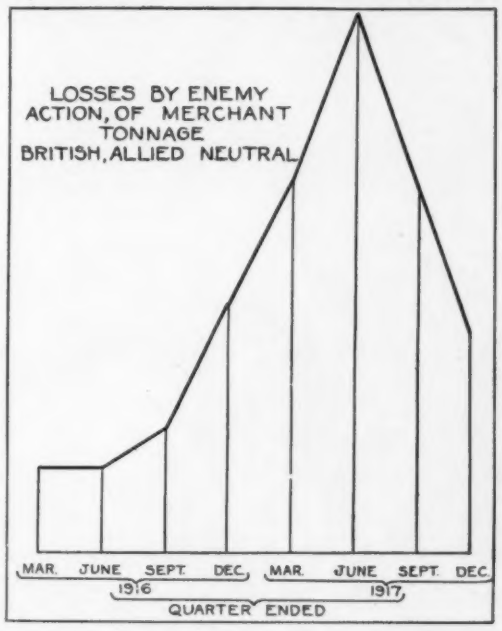
Clintonville, Wis.

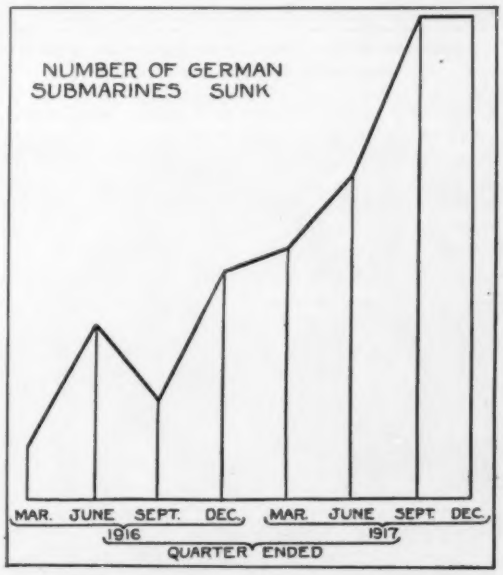
British Navy Defines Submarine Situation

IN view of the statement made by the First Lord of the Admiralty in the House of Commons, on the submarine war, to the effect that the general curves of merchant tonnage sunk by enemy action and of German submarines sunk are satisfactory, the British Admiralty determined to make public certain diagrams showing graphically the exact conditions. By the courtesy of the London *Daily Telegraph* we reproduce these Admiralty diagrams which, it will be seen, cover two full years of the submarine campaign.

It is explained by the Admiralty that with regard to the first diagram, the height of the curve showing enemy submarine attack upon merchantmen was reached in April 1917, which accounts for the quarter ending June showing the peak of the curve. Since that period the curve has steadily fallen, and in the last quarter of 1917 it reached the same figure as in the last quarter of 1916, which period antedated the unrestricted submarine attack.

The second diagram shows that, since the quarter ending September 1916, there has been a steady rise in the number of submarines sunk; and although for the last quarter of 1917 the number sunk has not shown any further rise, it must be remembered that at the time this diagram was drawn up by the Admiralty, there were still the results of half a month to add; nevertheless, the sinkings equal the results of the quarter ending September 1917.


LOSSES BY ENEMY ACTION, OF MERCHANT TONNAGE BRITISH, ALLIED NEUTRAL
MAR. JUNE SEPT. DEC. MAR. JUNE SEPT. DEC.
1916
1917
QUARTER ENDED



These diagrams are statistically accurate, based on facts up to December 27, 1917, and include no estimated or uncertain figures. They are diagrammatically accurate, and strictly to scale, but obviously not to a uniform scale

We draw attention to the note at the foot of the diagram which states that they are statistically accurate and drawn to scale, but that obviously the scale is not the same in both, one being for *tonnage* of merchant vessels and the other the *number* of submarines.

The Equipment of An Army

By Albert A. Hopkins, Author of "Our Army—Our Navy, How to Know Them"

IN 20 months the land forces of Great Britain were expanded from 200,000 to millions. To equip this vast army the markets of the world were combed for raw materials, or the finished product when it could be obtained. In some cases it meant that an industry had to be expanded 175 fold to meet the enormous demands of the emergency. The figures for textiles assumed vast proportions, 84,000,000 yards of flannel, 117,000,000 yards of woolen fabrics and 194,000,000 yards of cotton cloth were required. The looms ran tirelessly to turn out the yardage necessary, and after the cloth was in being, it was supplied to the contractors to be made up into uniforms and shirts. Of the latter 26,000,000 were required for ordinary field and training wear besides what was needed for hospital use. It must be remembered that soldiering is a hard business and clothing wears out very rapidly so that repairs and replacements must constantly be made. In even such a small tailor's finding as a button the figures are almost unthinkable, 840,000,000 being required. To come down to concrete figures as regards the uniforms, 2,507,000 officer's trousers and 11,004,000 breeches for the private soldiers were needed, as well as 11,490,000 jackets, 8,855,000 vests, 54,684,000 pairs of socks, 23,744,000 drawers and 4,836,000 overcoats. Of boots 21,750,000 pairs were required while 11,088,000 caps were needed.

To feed the soldiers 982,000 camp kettles and 9,450,000 mess tins had to be supplied, as well as 23,000,000 knives and forks, and 11,000,000 spoons.

There are good and sufficient reasons at this juncture for not entering too closely into details as to the extent and sources of the food supply. The steady maintenance of the fare for one of the best-fed armies in the world is one of the wonders of the world, and when all the real and scientific economies that have guided the whole system can be told, it will throw new light upon the knowledge of the world's resources.

To keep the camp and clothing clean 43,000,000 brushes were furnished, an astonishing total. This included brushes for harness and shaving brushes and nearly all the work of manufacturing them was done by women. The soldier must be protected from the elements and this suggests blankets and tents. Blankets to the number of 19,800,000 have been furnished, for the winter in France is very raw and cold, far different from the more equable climate of Gulf-Stream-washed England. For tents 54,000,000 yards of cotton duck were found necessary and to stay the canvas 33,000,000 tent pins were used. Horses came in for their share of supplies, 800,000,000 horseshoe nails and 140,000,000 frost nails being needed. The amount of harness required is almost incalculable although it appears that no figures are available.

When we consider the vast quantities of supplies needed to equip an army as indicated above, we should also consider that an army requires no less than 50,000 different articles. Is it any wonder that modern war taxes the resources of all nations to the breaking point?

State Activities of the Council of National Defense

THE broad character of the work being done by the Council of National Defense is shown by the following activities of the various State Councils:

Indiana.—The council, through the coöperation of the State Department of Education, is utilizing the public schools to provide skilled war workers. High-school students in the public schools are being given practical farming, home economics, and war industrial training as part of the curriculum.

Iowa.—The council has appealed to all school-teachers to begin immediately plans for home gardens and the time for starting preliminary work.

Montana.—The council has launched a State-wide campaign to organize councils in the school districts or precincts of each county. The county councils are urged to appoint a farmer, a general storekeeper, and a banker, merchant, or physician as a community executive committee to undertake the community organization.

PREVENTING LABOR WASTAGE

Oklahoma.—Vagrancy is a large factor in producing labor shortage. The State Council has joined the ranks of those State councils which are successfully stamping out vagrancy through securing in all counties a strenuous enforcement of the existing vagrancy laws.

Indiana.—In time of war a strike is a military disaster. The council reports that it has been successful in preventing strikes by calling representatives of the employees and employers into conferences with its labor committee, which represents labor and capital equally.

SPEAKERS

Indiana.—The council is helping its speakers' bureau to talk facts by maintaining a speakers' library.

Arkansas.—The council sent distinguished men on a special train to tour the State on an advertised route, stopping at small towns to address the crowds which gathered at the stations.

Rhode Island.—Close touch with the friends and relatives at home builds up the morale of our men at the front. Relatives and friends often get out of touch solely from ignorance. The council is operating an information bureau with trained workers to help all people to write their friends in the service.

Micro-Photoplays

Staging Motion-Picture Productions with the Aid of the Microscope

By Austin C. Lescarboura

A DROP of water taken from a stagnant pond is rich in motion-picture possibilities. To be sure, it does not present extraordinary promise when viewed with the naked eye, but under the critical gaze of the microscope a new world is thrown open to the camera. For, with the drop of water as the "location," and with the myriads of micro-organisms for the cast, there are comedies and dramas and educational features without end for the motion-picture screen.

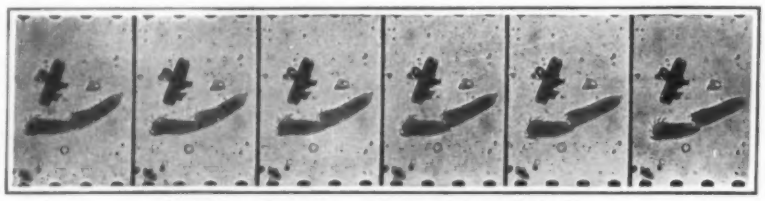
For us the filming of micro-organisms is a novelty. Previous to the war this class of motion-picture photography was practically a French monopoly; and from the splendidly-equipped laboratories of French producers there issued reel after reel of wonderful subjects depicting the activities of the invisible world. The demand for such films in America was inconsiderable then; certainly out of all proportion with the expense and trouble involved; hence our producers gave no further thought to the micro-photoplay. But with the increasing interest in popular scientific films conditions have changed. Indeed, we have been obliged to undertake the task, difficult as it is; and today the presentation of American-made micro-photoplays in many of our theaters is ample evidence of our success.

Directing Amoebae, Rhizopods and the Like

One would suppose that the micro-photoplay studio would be located in the country, with Nature close at hand. As a matter of fact, however, the majority of films of this kind are being made in a glass-encased studio on the roof of a New York city skyscraper, far from all traces of Nature unless it be the sun and clouds above. To this studio are brought the various samples of stagnant water and insects and other subjects to be filmed. They arrive in small vials, test tubes, large bottles and pill-boxes; in truth, the transportation problem is so readily solved in the case of these little performers that the studio can be located almost anywhere. That is why it is found in the big city, where other advantages are greatest.

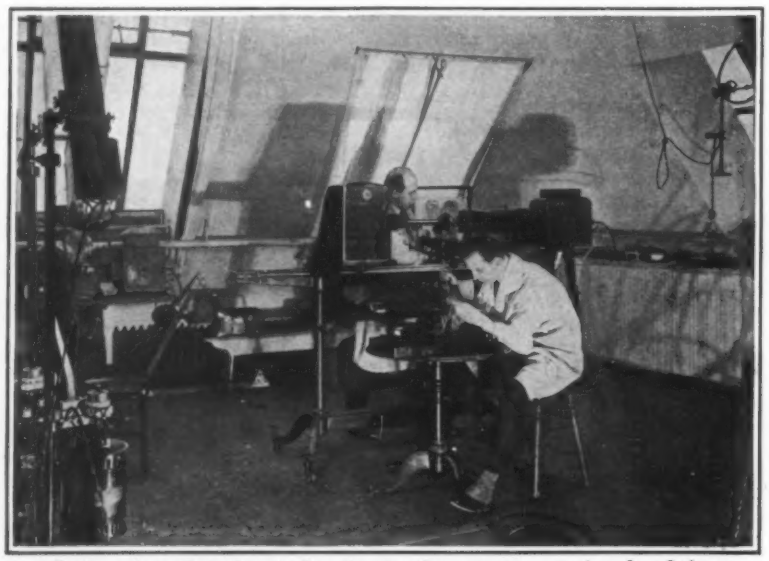
The first qualification of the micro-photoplay director is that he must be a born naturalist: he must not only be intensely interested in all forms of animal life, but must be intimately familiar with the subject. He must be ingenious; for the filming of the little performers calls for no mean ability at times. He must be a skilled photographer; for in the main the work is one of photography. And, of course, he must know what is interesting to the public and know how to tell a story in pictures so that it will be entertaining and instructive.

All of these qualifications are possessed by Horace D. Ashton of New York city, who is directing the micro-photoplays in the skyscraper studio. Born and raised on the farm, a student of natural history, a press photographer for many years, a magazine correspondent, a motion-picture cameraman, Mr. Ashton happens to be the fortunate combination for such work. Most important of all, his hobby is natural history.



A strip of negative film from a micro-photoplay

Far from being a battle between a biplane and a Zeppelin, this film depicts a stentor in the act of dividing and becoming two animals. Beside it can be seen a diatom—one of the "jewels of the invisible world"—a plant with the power of motion



In the micro-photoplay studio, showing the apparatus employed and the preparation of microscope slides

For some time past Mr. Ashton has been filming micro-organisms for the lay audience. Starting with the simplest form of life, namely, the amoeba or simple cell, he and his assistants, in coöperation with the American Museum of Natural History, have been progressing with a series of films, which, when completed, will represent all stages of animal life. All indications at present are that the work will require years, for it is perforce exceedingly slow and painstaking.

The day I called on Mr. Ashton he happened to have three small aquaria on the laboratory table. One of these contained water taken from the Bronx river, another from a pond near Flushing, L. I., the third from a pool in the woods near Tenafly, N. J. Beyond a doubt the last was the pride of the micro-photoplay director; for as he explained, he had walked five miles along the Palisades the previous Sunday in search of this particular fluid—a slimy water, rich in animal life.

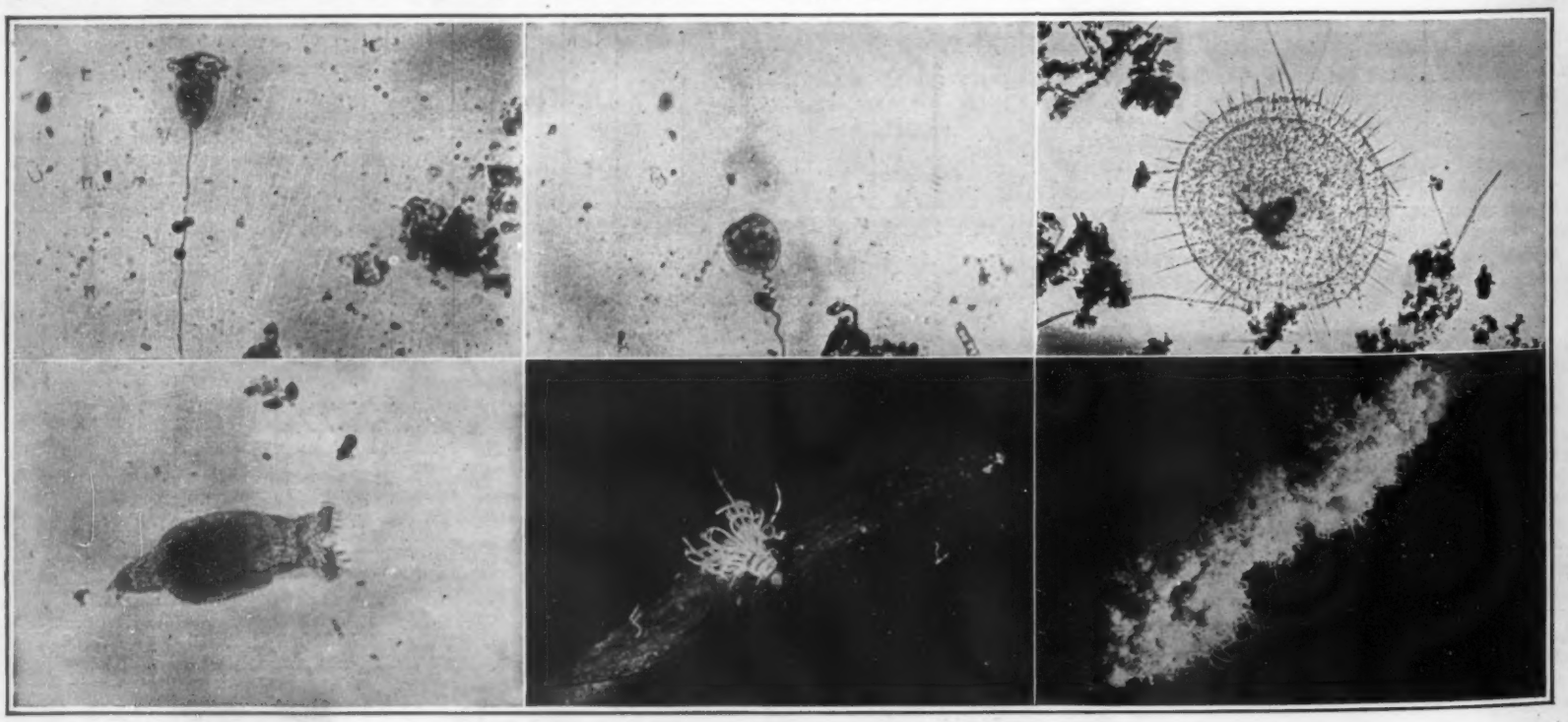
Plunging a glass tube into the Tenafly sample, Mr. Ashton explored some silt at the bottom until he evidently found what he was after. Then placing a finger on the top of the tube, he removed it from the aquarium and released its contents on a microscope slide. A moment later he was studying the sample under a microscope. Then he asked me to examine a splendid specimen of rotifer vulgaris, which at that moment was working its paddle-like head so as to suck food into its mouth much after the plan of a vacuum cleaner passing over a dusty carpet.

Light—Camera—Action!

It is a long step from examining a specimen under the microscope to making a motion picture of it. The mechanical difficulties are manifold, though in principle one simply replaces the human eye with the camera and the reflecting mirror with a powerful source of artificial light. In practice, the work is carried out in this fashion:

The director, after preparing the microscope slide in the usual manner and placing it on the stage of the microscope which is then in position on the photographing stand, adjusts his instrument until the desired view is obtained. The slide, of course, is provided with a cover glass so that it can be tilted to any position. Then the microscope is turned horizontally, and its eye-piece and reflecting mirror are removed. The eye-piece is replaced by a motion-picture camera the lens of which has been removed, while the reflecting mirror is now represented by a powerful lantern fitted with condensers, supplementary condensers and special color filters.

In his work Mr. Ashton makes use of a Moy camera, which is provided with a peep hole at the back through which the image can be seen on the film, in greatly



Typical scenes from micro-photoplays produced in the United States

Top row, left to right: The vorticella or bell animalcule extended and feeding by revolving the cilia or edge of the cup-shaped head. (400 diameters). The vorticella when disturbed contracts instantly and the stem assumes the appearance of a coiled spring. (400 diameters). The actinospherium—a rhizopod of beautiful form. It is seen here digesting a white water mite. (500 diameters). *Bottom row, left to right:* The rotifer vulgaris, which appears to have "wheels in its head." In reality it has two rows of fine cilia which are rotated in unison, creating a current for bringing food to it. (400 diameters). The woolly alder-blight from Central Park, New York City, which is the "Hoola Dancer" of the insect world. (10 diameters). A group of the woolly alder-blight on an alder twig

magnified form. So by providing his camera with a light-proof hood or cover it is possible for him to watch his subject while the pictures are being made, and to focus at any instant if conditions are altered. What is more, by means of this method it is possible to follow a performer about the slide by the usual movements of the microscope stage, just as the outdoor cameraman can follow a player about the scene by turning the crank of his tripod.

So sensitive are the animalculae that they can be left only for a short period in the strong light necessary to photograph them. As a general rule a film must be made in from forty to fifty seconds, and an extension of the period generally results in killing the performer. In one case, however, 200 feet of film was made at a stretch, but this is exceptional. Obviously, this fact makes for quick action once the actual filming is started, and Mr. Ashton is of the opinion that once he attempts to film still more sensitive micro-organisms it will be necessary to use a shutter in the path of light so as to provide intervals of rest for the subjects. The French in some of their work have made use of a shutter which operates in synchronism with the camera shutter, so that the specimens have intervals of rest instead of being subjected to continuous light.

Special types of condensers of the liquid variety, making use of different chemicals, have also proved a great help in bettering the photographic conditions and increasing the longevity of the micro-organisms.

Prison Cells and Strait-jackets for Frivolous Players

In justice to animalculae as a class be it said that they are usually willing enough to be filmed; for being slow of movement it is a simple matter to keep them in the field of the camera. And even if they should suddenly acquire the wanderlust, their movements can be readily followed about by shifting the stage as already described. But occasionally the director is confronted with a frivolous performer—one that insists on scampering about in the most disconcerting manner.

While it may be true that a drop of water is not a very great area in the usual sense, when the high power microscope is applied to it the area then corresponds to a pond of respectable size. So when the animalcule decides to saunter off to parts unknown the search is not unlike that of trying to locate a fish in a large pond. Here, however, the director's ingenuity comes into play. For he provides for just such an occasion by keeping on hand a number of thin aluminum strips in which he has punched a square or round hole. By placing an aluminum strip on a slide so as to box in the specimen, he effectively limits the field of operation when the actual filming takes place. No matter where the performer's fancy may take him, he is still within the range of the camera.

Again, there are times when the anatomy of a specimen is to be filmed. In this case it is essential to have the specimen remain in one position. Some are docile in this respect; others are not. The latter are soon tamed, however, by the resourceful director. He makes use of a special slide which has two glasses, a fixed bottom one and an adjustable top one. The top glass is mounted in a threaded ring which screws on a hollow stud, so that by turning the top glass it is brought closer and closer to the bottom glass, while maintaining at all times the parallel arrangement. The obstreperous performer is placed in this chamber of horrors, and as in the familiar lithographs of by-gone melodramas the moving wall gradually closes in upon him. But in this case the movement is stopped when the specimen is slightly squeezed, there being no desire to crush him.

In photographing mosquito larvae a little trough was constructed in which to place the specimens. This consisted merely of the usual slide on which was cemented another sheet of glass provided with a half-circle notch, and then another glass to cover the notch. In this manner a pond-like stage was provided. The mosquito larvae, swimming about the water and coming up to the surface for air, were followed by the adjustments on the microscope stage.

One of Mr. Ashton's invariable habits is to look after the welfare of his invisible performers. After a scene is filmed he dismantles the stage or microscope slide and returns the water with its charges into the aquarium from which it was originally drawn. Obviously, it would be simpler to shake the drop of water on the floor or to wipe it off with a towel or handkerchief. Perhaps sentiment is the predominant factor which moves this director to return the micro-organisms to their glass-bound habitat. However that may be, the fact remains that the performers, none the worse from their experience, are kept alive and ready for another call when this humane course is followed.

The micro-photoplay director studying a micro-organism preparatory to filming

The micro-photoplay has a big field to draw upon, aside from studies of animal life. In chemistry we may exhibit the formation of crystals and other marvels. Just as the French have already done, it is possible to show various disease germs and how they affect the human system. The circulation of blood can be filmed, as well as other functions of the human body. Surely we have but scratched the surface, and much can be expected in this latest field of American cinematography in the no distant future.

Frictionless Freight Handling

FREIGHT handling with a minimum of friction has been developed recently upon Piers 4 and 5 of the Pennsylvania Railroad in New York; and in view of the fact that congestion at the terminals is a national problem, the present solution of it is of more than local interest. The factors that have made for the present efficiency are mechanical appliances to replace hand labor, and a scientific planning of the freight movement from the loading platform, through the pier and to the freight car.

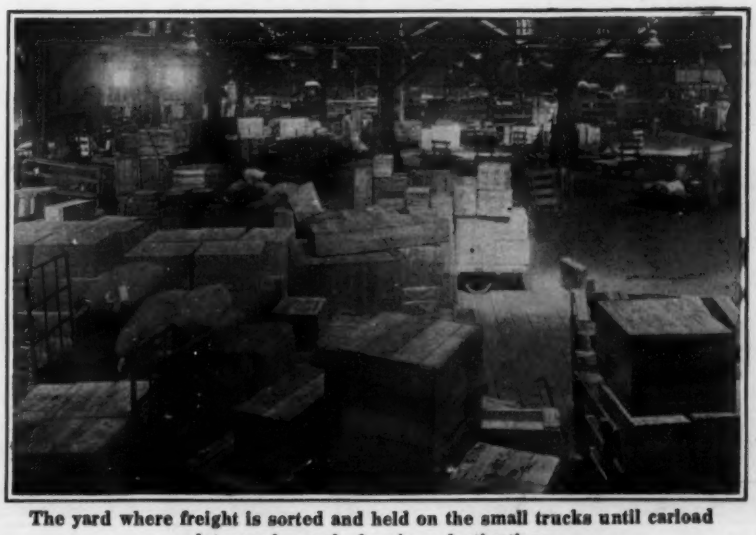
The use of electric industrial trucks is not new in itself, for they are a familiar sight at most large railway stations, but the employment of a huge number of hand trucks that may be attached as trailers to the "electric stevedores" has been developed here to a remarkable degree. About two hundred and fifty of these hand trucks are used with five tractors. All the vehicles are so narrow that they can operate through doorways, along loading platforms and between the piles of freight on a dock; while, as we recently brought out in a discussion of the industrial trackless train, these little cars follow their leader surprisingly well around all sorts of curves.

The use of manual labor in shifting cases and bales has been cut down to a minimum by loading from the dray direct to a hand truck, and keeping the freight on that same truck until it is deposited in the freight car. Thus there is no dumping of goods upon a loading platform, to be sorted out over and over again and moved from place to place by hand barrows. Instead of that laborious process, the drayman delivers his load direct to the hand truck. In case it is all consigned to one destination the small vehicles are set at the rear of the dray, and when they are filled, a tractor takes charge of the entire string of trailers and hauls them to the freight car, or to that part of the pier known as the yard, where carload lots are made up. In either case, the loads remain on the trailers until they are stowed away in the freight car.

In case the dray brings packages designed for a number of points, the procedure is different. At the inner side of the loading platform stands a series of waiting hand trucks, each ranged under a certain numeral that is suspended from a rod overhead. Each numeral corresponds with a certain routing, and the man in charge on the platform knows by a glance at the address whether a case should go on truck number 38 or 36 or 34. It is transferred direct to the proper hand truck, and in order to make that slight operation swift and easy, the loading platform is raised to such a height that the floor of the truck is on a level with it. Thus instead of piling a drayload of freight on the platform to be sorted out and handled several times, the load is placed at once upon the trailer which is to convey it to the car.

As soon as a trailer is full, it is replaced by an empty one; and a tractor picks up the loaded truck, couples it to a train of others that are ready and hauls it to the "yard." There the trailers are grouped according to the number, 38, 36, etc., and held until there are enough in a given group to make a carload. Then a tractor hauls them aboard a lighter, where a car is in readiness, bearing the corresponding numeral on the door. The string of trailers is left there to be swiftly unloaded; the little vehicle can be shoved half way into the box car and men inside can stow the packages with the slightest possible labor, for it is evident that all waste movement is eliminated. On its return trip, the tractor picks up a string of empty trailers and delivers them at the loading platforms ready for further use.

How freight is handled at the terminal without friction and with a saving of labor



The yard where freight is sorted and held on the small trucks until carload lots can be made for given destinations

The capacity of these diminutive tractors is remarkable. They handle a load of 17 tons on the level and will convey from four to seven loaded trailers through the pier, along the platforms and up the inclines to the lighters without difficulty. One man acts as driver, and a second as conductor, the latter having the duty of coupling and uncoupling the trailers. The miniature trains move at a speed of four miles an hour, or about four times as fast as laborers with hand barrows, and it is estimated that on many loads the two men accomplish in one-fourth the time the work of a dozen or so stevedores, as shown in one of the illustrations.

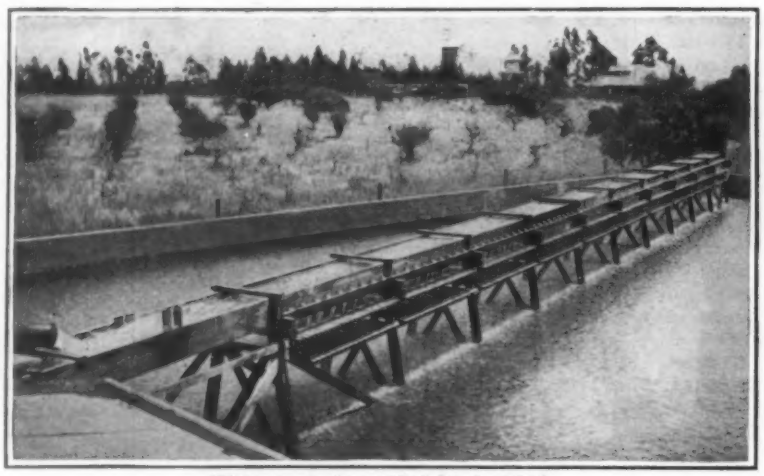
Several hours a day are gained at the piers by this system. Moreover, the expediting of freight handling has done away with the long lines of teams and drays that stood for half a day at a time under former conditions. That means much to the public, alike to the shipper who pays the bill in the first instance and to the consumer who must ultimately bear the burden in increased retail price.

The present methods have relieved that condition, and the results are so satisfactory that equipment has been ordered to extend the system of frictionless freight handling to three other piers of the same railroad in the vicinity of New York.

Blowing the Bad Taste Out of Sulfur Water

A DOMESTIC water company at The Palms, Cal., depends upon its water supply from a single deep well. The water coming from this is heavily impregnated with sulfur gas and although very good in other respects is distasteful to the inhabitants of the town. So serious was the objection raised against the water by the populace that at one time it looked as though the water company would be driven out of business.

The company's engineer finally came forward with a solution of the difficulty. A long trough was constructed upon supports over a storage reservoir and the water from the well discharged into it. From the trough the water escapes in small jets through one-inch holes bored along both sides of the trough near the bottom. The complete aeration of the water is effected by still further atomizing it in allowing it to fall over two shelves of laths which break it into minute drops. When a slight breeze is blowing it so clears the water of sulfurous gases that hardly a trace of sulfur is noticed in drinking the water of the reservoir immediately after it is pumped. By the time this aerated water reaches town homes there is absolutely no taste of sulfur in it.



Where water is purified by the wind

Better Cotton Bales

THE cotton bale bulks overlarge at present: it is taking up too much room in our freight cars and ocean-going shipping. Transportational space is at a premium, and raw cotton, as we carry it now, demands a disproportionate measure of it. But cotton must be moved in order to supply the basis of explosives and vitally needed textiles both for our Allies and for our fighting men at home and abroad.

Our way of handling cotton in transit has entailed an annual loss heretofore of quite $75,000,000 between its departure from the producer and its arrival at the cotton mills. Today, with cotton high, the yearly sacrifice is much greater. The primary cause of this wastage is the comparatively crude fashion in which our native staple is generally baled. A far bigger monetary loss confronts us because of present freight rates and the scarcity of cars and bottoms.

The run of plantation bales, as they are shipped from the gin, have a density of eleven pounds per cubic foot, and on an average, 25 of these fill an ordinary car. After recompression and strapping at the nearest railroad compress their bulk is so reduced that two cars will hold 100 bales of a density then of 22 pounds per cubic foot. The more improved apparatus turns out square bales, covered with burlap and carefully strapped, that have a density of from twenty-eight to thirty-five pounds per cubic foot, and thus effect a material saving in car or hold space. If our cotton were baled as it is elsewhere, particularly in the Far East, one car could easily accommodate 100 bales, thus releasing, for other uses, half of the cars now required.

In Egypt, the staple is packed in bales having a density of 37 pounds per cubic foot. In India the density averages something like 45 pounds per cubic foot; while in the best equipped of the Indian and Chinese baling plants the density ranges from fifty-five to sixty pounds per cubic foot. This is made possible by the extensive employment of thoroughly up-to-date hydraulic compressers. With us, steam apparatus is still used, and this lacks the power to compact the cotton most economically.

It has been urged here, as an excuse for not installing modern equipment, that high compression might damage the staple. This objection has no foundation in fact. The Department of Agriculture has given this matter most careful study; and its experts have reported that the increased density does not affect the grade of the cotton. After removal from a densely packed bale, the cotton was found to recover its original appearance in the course of twenty-four to forty-eight hours, and upon further examination was proved to be in no wise injured.

High density cotton compress at work in a New Orleans warehouse

We are confronted with the problem of keeping our northern cotton mills supplied with the raw staple, of delivering the cotton needed by our powder plants, and of sending across the Atlantic hundreds of thousands of bales. According to the latest governmental figures, our railroads moved, in 1915, no fewer than 5,012,705 short tons of cotton; and in 1916 we exported 1,542,035 tons of the staple. Prior to the first of November, just past, the cotton ginned in the United States amounted to 7,150,254 bales. In a single season we have shipped to Europe as many as 8,000,000 bales; but at the present time our exports are not in excess of 6,000,000 bales.

Assuming that the average freighter built and building here will have a deadweight capacity of 4,000 tons, and allowing 40 cubic feet per freight-ton, that means an available cargo space in each ship of 160,000 cubic feet. Taking the Government figures available, it would seem that probably 90 per cent of our bales, as they stand ready for export, have a bulk of 26 cubic feet each, and the remaining 10 per cent, because of their higher density of compression, call for 16 cubic feet of space apiece. A 4,000-ton ship would carry 6,154 bales of the 26-cubic-foot type, which would represent approximately a deadweight of 1,800 tons. These would completely fill the hold space. Again, the 16-cubic-foot bales to fill a 4,000-ton ship would number 10,000 and would represent a deadweight of approximately 2,875 tons. The wastage of tonnage is large in both cases. We can make the situation somewhat clearer by further analysis.

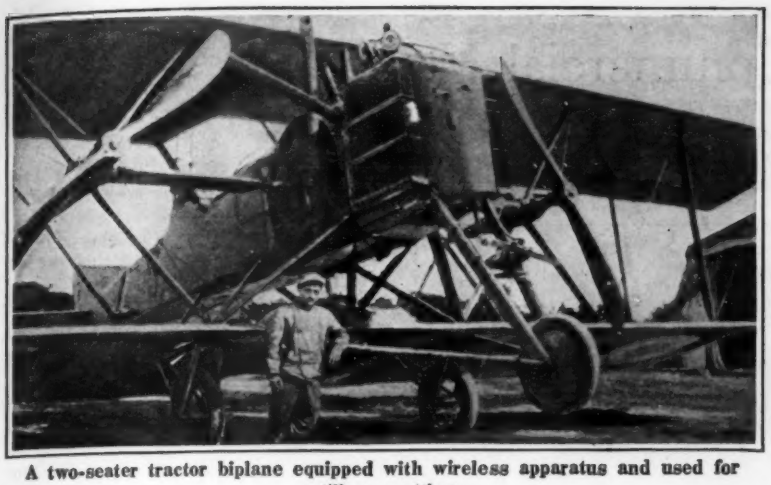
To move nine-tenths of 6,000,000 bales—assuming each bale to average 575 pounds—would call for not fewer than 878 vessels of 4,000 tons deadweight capacity, and the other tenth, our so-called high-density bales, would require 60 vessels of the same capacity. That is to say, we should need a total of 938 ships of the size mentioned to carry 6,000,000 bales of cotton from this country to Europe. If, on the other hand, we compressed all of our cotton to a density of 55 pounds per cubic foot, as is so widely done in the Orient, only 431 steamers of 4,000 tons deadweight capacity would be required for the service mentioned. These vessels would actually not be packed to space capacity, because their holds if filled with the extra-dense bales would have a load of 4,400 tons. In other words, the ships can be laden in part with these bales and the remaining cargo space could then be given over to bulkier but lighter freight in order to make the best use of the tonnage available.

Assuming that 75 per cent of the ships are able to avoid destruction long enough to make two trips, and granting that 25 per cent of them are sunk before reaching their destinations in Europe on their first voyage, it is self-evident that 431 steamers would make it certain for us to deliver the needful cotton to our Allies and still have tonnage enough left of this fleet to render other valuable service. As against 938 ships of 4,000 tons, called for to handle our cotton as we now compress it, bales of a density of 55 pounds to the cubic foot would result in a reduction of 507 steamers to transport 6,000,000 bales.

Taking the average price of steel ships under construction for the Emergency Shipping Corporation to be $160 per ton, we should save by increasing the density of our cotton bales substantially $324,280,000 in steamer tonnage. Not only that, but we should make sure of utilizing our coastal freighters as well as our available railroad cars to far greater advantage. The domestic phase of this problem is of prime importance, because our northern mills manufacture annually something like 3,000,000 bales of cotton, and they must be supplied with the raw staple. The installation of thoroughly modern cotton presses, that would give us a standard bale of 55 pounds to the cubic foot, would involve a very heavy outlay. But, even so, it would be cheaper, by far, in the end, than the building of a fleet sufficiently numerous to handle our bales as they are now made up.

Square bales made under a pressure of 35 pounds and well covered with burlap

The ordinary bale as it looks after handling



A two-seater tractor biplane equipped with wireless apparatus and used for artillery spotting

In the observer's nacelle, showing the handle of the Lewis gun above, and the wireless apparatus below

Wireless-Equipped Airplane for Artillery Spotting

TYPICAL of the artillery spotting airplanes now in use over the Western front is that shown in the accompanying illustrations, which has all the marks of having been designed and built for this work, in contrast to the former practice of equipping the usual run of two-seater machines with wireless apparatus.

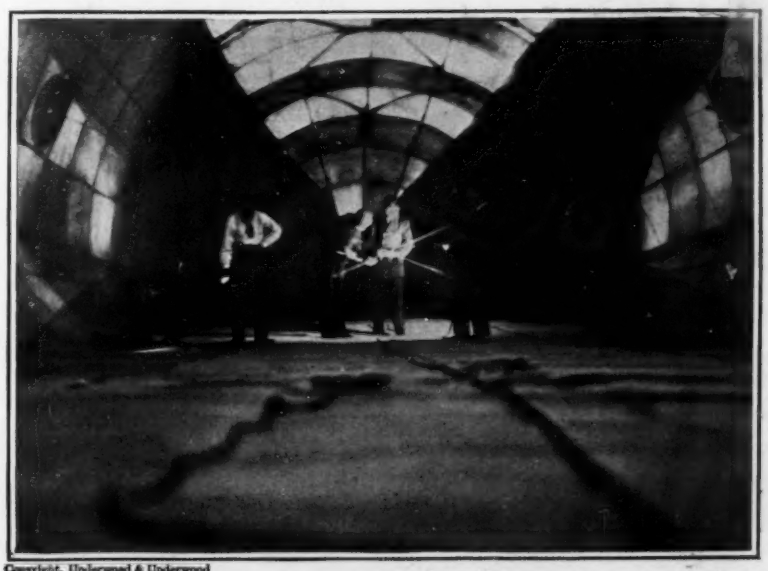
The airplane illustrated is a two-seater equipped with a pair of tractor screws driven by the common power plant through shafting and bevel gears. This design makes possible the placing of the observer in front, while the power plant is placed back of him, between his nacelle and the cockpit of the pilot. The radiators are placed at the side of the observer's nacelle where they do not interfere with the view; indeed, the observer can gaze below through a glazed window in the floor of his compartment. Although the plane is no doubt convoyed by battleplanes while engaged in artillery spotting, it is provided with a Lewis gun mounted on a swivel and elevating carriage above the observer.

The wireless apparatus consisting only of a transmitter, is placed in the observer's nacelle. The sending key and adjustable spark gap are mounted on a shelf in front of the operator, while just below is the reel carrying the aerial wire which passes out through a tube in the floor. Current for the transmitter is obtained from a small generator mounted on two members of the landing chassis and equipped with a small propeller so as to be wind-driven. This insures a constant source of power even when the airplane engine is shut off and the airplane is volplaning.

Why Not Convert the Winter Passenger Car Into a Power-Driven Sleigh?

WHERE snow is plentiful the sleigh is used in preference to the wheeled vehicle, because it rides much easier. Why not, then, convert the automobile into a power-driven sleigh during the winter season, when one is sure to have snow along the entire route? The accompanying illustration of one of the automobiles belonging to the ex-Czar of Russia shows how simple it is to convert the average passenger car into a highly efficient power sleigh. The front wheels are supported on detachable runners while the rear wheels are replaced by a tractor belt arrangement. Thus converted, a car is able to glide over the snow and ice at a high rate of speed and in complete safety. It is said that this high power car is capable of a speed of 100 miles an hour over an absolutely smooth and frozen surface.

Improvised power sleigh of the ex-Czar of Russia, operated by means of leather belts with rubber facings



Copyright, Underwood & Underwood

Officers of the British Royal Naval Air Service being taught to repair kite balloons from the inside

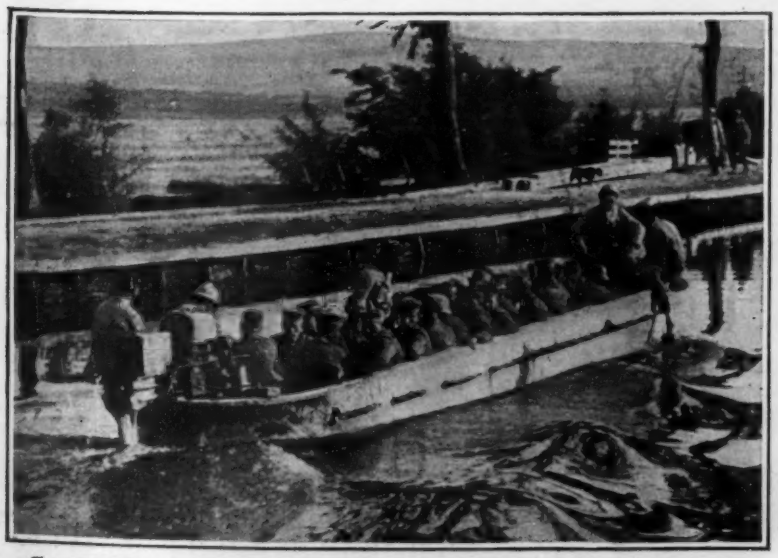
Pontoons With Detachable Power Plants As War-Zone Ferry Boats

THE numerous canals which cross and recross much of the territory back of the French lines have been put to good use by the military authorities, not only for the transportation of supplies and floating batteries, but as a fairly rapid means of travel between different points.

By equipping pontoons with detachable engines the French army has secured a fleet of fairly fast and very serviceable motor craft for ferry service on the canals. Officers, men and prisoners are transported from place to place in these comfortable boats, and it goes without saying that this ferry service has proved of great value as an adjunct to usual transportation means. The power plants are usually of about twelve horse-power rating, and include the engine and accessories, propeller and rudder, all in one unit, fastened to the stern of the pontoon.

What Does the Interior of a Kite-Balloon Look Like?

THAT the inspection and repairing of kite-balloons is strictly an "inside job" is evident from the accompanying illustration, which depicts the interior of a gas bag undergoing a thorough examination. In this case the bag, inflated with air, is resting on the ground or floor, and the men walk about in comparative ease.



German prisoners captured by the French on the Verdun front, being transported in a pontoon ferry boat

Chinese military mission on a visit to the Verdun front, via the pontoon ferry boat route

The Motor-Driven Commercial Vehicle

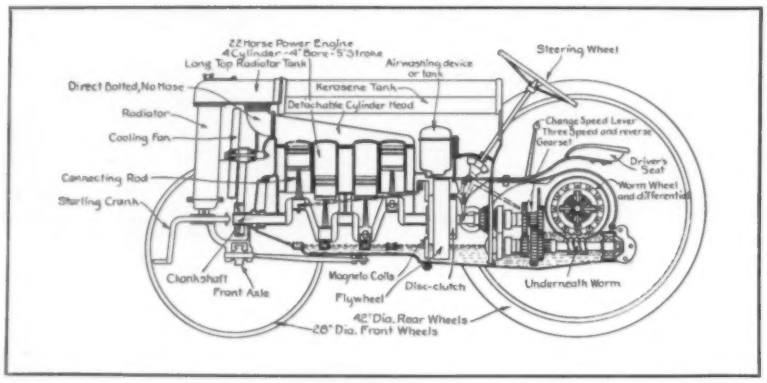
Conducted by VICTOR W. PAGÉ, M.S.A.E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

New Farm Tractor Burning Kerosene

THE manufacturer of a very popular small car has developed a small farm tractor which is to be produced at the present time at the rate of 50 per day and which will be sold at a very low cost. This, of course, is made possible by the application of the same methods of quantity production that has popularized the low-priced automobile. The new tractor has numerous features of interest, and as will be evident from the part sectional diagram sketch it is of simple and substantial construction. It has been especially designed with a view to using kerosene as fuel and it is said that changes that may be easily made will enable it to run on alcohol. The tractor illustrated has no frame such as the conventional machines are fitted with, but the engine, change-speed gearing and rear-axle housing are all bolted together to form a unit which replaces the frame of the ordinary tractor, as the axles are attached to this unit as well as the other necessary appliances. Ignition current is obtained by a novel form of flywheel magneto which has been developed on the passenger cars built by the same maker. The engine is of four-cylinder, four-cycle type, and drives a sliding gear transmission through the medium of a disk clutch. The drive to the rear axle is of the worm gear type, so that all change speed gearing and drive gearing run in an oil bath and are also completely protected from dirt and grit, which cannot always be said of similar members in tractors of more conventional design. The rear wheels are 42 inches in diameter and the front wheels 2 feet 1 inches in diameter.

The entire machine weighs but 2,500 pounds. The machine is capable of exerting a drawbar pull of 1,500 pounds which is sufficient to pull two plowshares in very heavy soil when working on an intermediate speed of 2.7 miles per hour. The machine will turn in a circle having a radius of 21 feet. The four-cylinder engine has a 4-inch bore and a 5-inch stroke and is rated at 22 horse-power at 1,000 revolutions per minute. This power rating is obtained with the low compression pressure necessary to use kerosene properly. The fuel supply is carried in a 23-gallon tank mounted over the engine and supported at the front end by an extension of the radiator and at the rear end by a simple band iron frame. As gasoline is used for starting, a small tank holding a quart is provided. The kerosene is turned on only when the engine has become properly heated. In order to simplify the construction, the thermo-syphon system of cooling is used, the engine being provided with exceptionally large water jackets and the water system having a capacity of 11 gallons. The design has been very carefully considered with a view to quantity production and it is expected that it will be marketed at a price that will bring it within reach of the small farm owner, who heretofore has been unable to purchase a reliable tractor at a reasonable price. In addition to the usual form of drawbar, the tractor is provided with a pulley so that it can be used as a portable power plant for operating machines needing belt power.



A new small tractor built for service on the farm which has been designed for quantity production at less cost. The engine is adapted to be operated on kerosene or on alcohol

Truck with Orange Peel Bucket for Cleaning Catch Basins

A FIVE-TON truck has been placed in service recently in New York city with a novel equipment for cleaning catch basins, and has demonstrated that a substantial saving in money can be effected by this device. It consists of a crane and an orange peel bucket, which is lowered into the manhole and dredges out the contents, emptying them into the metal body of the vehicle.

The crane is operated by the power take-off, the energy being supplied by the engine of the truck, and it is controlled by the chauffeur, who stands upon a small platform beside the crane. An assistant directs the orange peel bucket into the manhole, and when it touches bottom gives the signal to operate the piston which causes the bucket to close about a load of sediment. Then at a touch of the lever the drum revolves and winds up the chain until the bucket is higher than the edge of the truck body, when a third man swings the crane around over the tank and the bucket is emptied.

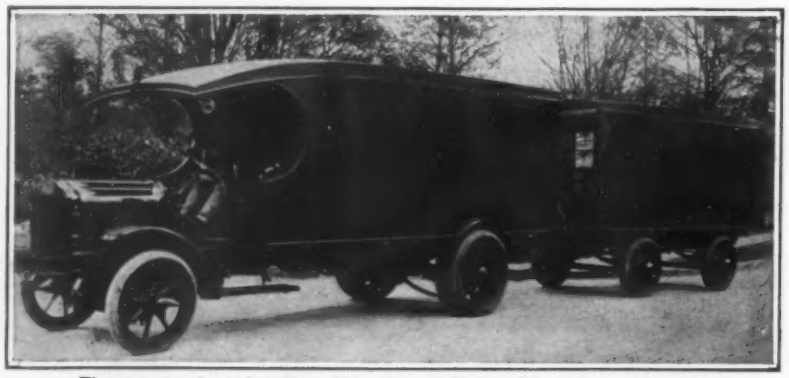
This operation is repeated until the contents of the catch basin have been removed, and it requires only a fraction of the time used by the former method, which was to send a laborer down into the sewer to fill the buckets with a shovel. In fact, it was sometimes necessary for him to use his hands in getting the larger obstructions to the surface, and this work was not only slow, but also extremely disagreeable. As it is not easy to secure labor for ordinary work at present, it is doubly difficult to find men willing to undertake this unpleasant task, so the use of the grab bucket helps solve the labor problem for the Department of Sewers.

The number of men required by this method is far less than by the former way of doing the work, as a single truck with a driver and two helpers is as effective as a gang composed of four laborers, one foreman, four drivers, and four one-horse carts, a total of nine men and four horses. This saving is considerable; even allowing 25 per cent for depreciation of the truck, there is a difference of 15 per cent in favor of the new apparatus, while it is estimated that at least one-third can be saved by some improvements that are now contemplated. Whereas a horse-drawn cart requires an hour to transport a cubic yard from 180th Street to the dump at 130th Street and the North River, the truck will carry five cubic yards the same distance in 25 minutes.

Cleaning a sewer basin without going down the manhole

The Motor Truck on the Farm

JUST as motor trucks are gradually displacing horses in our big cities, their advantages are making them serious competitors of horses on our farms where the horse is considerably more useful than it is in the city. There is a variety of farm work that can only be accomplished economically by using animal power, but, for the most part, much of the farm work can be done by mechanical power. This is especially true of the delivery of produce to the market and the return trip with necessary supplies for the farm. In former times, when horse-drawn vehicles were universally employed, garden truck farmers could not be located very far from their markets because of the time consumed in carrying the produce by the slow animal-drawn transportation means. In some cases it was necessary for a farmer to travel all night in order to reach a market but fifteen to twenty miles away from the farm. Naturally the time spent in this way could not be utilized for anything else and so much time was taken away from the other farm tasks that only two or three trips were made per week. The motor truck has demonstrated its capacity for transporting farm produce very quickly. If a farm is located 20 miles away from the market, instead of traveling all night the farmer can leave in the early morning and arrive at his market in a relatively short time. The average heavy truck, even when fully loaded, is capable of a speed of ten miles per hour so that the trip to market that used to take five hours with horses, can be made in two hours with a motor truck.



Five-ton truck and trailer of equal capacity used by a large farm for hauling produce to market

Three-ton truck employed to haul produce of a farming community

In some communities, where the farms are small and where the amount of produce raised would not be sufficient to warrant each farm to own its own truck, it is customary for some one of the community who does own a truck of large capacity to bring in his neighbor's produce for a nominal sum. A three-ton truck that is utilized in this way is shown in the illustration on this page. As it serves a community it can always take a full load to market. It is said that it will carry 250 crates of asparagus or cantaloupe or 500 to 700 baskets of tomatoes or similar produce. This truck operates under a regular schedule from April to September between its owner's farm and the market in a neighboring large city. Collections of produce are made at the various farms along the route and the driver collects the

(Concluded on page 78)

The Man Who Uses a "Home-made" Heat Treating Furnace Today Courts Disaster

A furnace made of odd fire brick and iron plates in accordance with one man's idea, *may* produce acceptable results. These results, however, will be far different from those obtained with a standard furnace, built strictly in accordance with known scientific laws and the best engineering practice and according to proven data.

The manufacturer requiring a furnace should select from a standard line made by furnace engineers, whose ability and reputation are beyond dispute. Furnace design and manufacturing is just as distinctive a line of work as any other business.

In this day of the nation's emergency, the speeding up and increase of output should command the attention of every manufacturer. Home-made, make-shift appliances should not be tolerated. It is absolutely essential that standardized furnaces be used in order that waste effort and labor may be eliminated; so that time may be conserved; so that fuel may be saved.

Fully one-third to one-fourth of all the gaseous and liquid fuels burned in this country today could be saved if properly designed furnaces and combustion appliances were used.

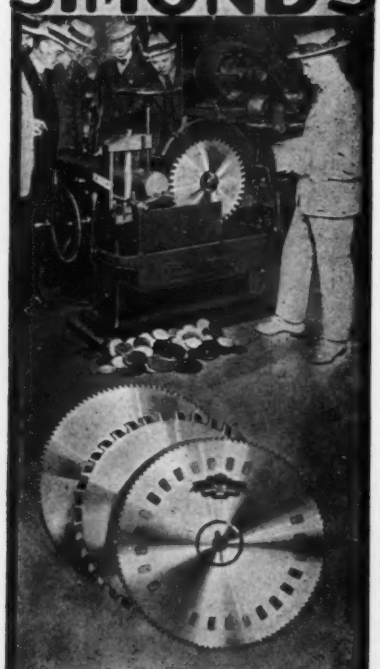
Tate-Jones Heat Treating Furnaces meet these requirements and are standardized. With them, today's results can be duplicated tomorrow. There is a furnace suited to each heat treating process.

Write for catalog giving some idea of your requirements and we will offer suggestions. It is quite probable that we can show you a regular Tate-Jones furnace to do the work which you thought possible only in one of "Special" size or design.

TATE-JONES & CO., Inc.
Established 1898
Furnace Engineers
Pittsburgh, Pa.

A Tate-Jones Pack Hardening Furnace

SIMONDS



THE TEST
is always met with success and satisfaction if you have

SIMONDS SAWS

Write us about installations of any kind or size saws for cutting metal or wool, metal cutters or slotters.

Simonds Manufacturing Co.
"The Saw Makers"
Established 1832
FITCHBURG, MASS.
Five Factories Eleven Branches

Uncle Sam's Ground School for Flyers

(Concluded from page 69)

light of an exploding shell, how it is located, and what sort of signals to send down to earth that they who are shooting, or being shot at, may know what to do with their guns of offense and defense.

The instruction in all the work is practical. Theory is included, but theory comes second. It is less important that a man know how a wireless functions than that he know how to work it. It is not so vital that the pilot understand the theory of gunnery, as that he know how to help his gunners. And it is practice, practice, practice which the ground school student has, all day long.

Some drop by the wayside. Not all who take the course are certified as having within them the makings of competent pilots or observers. Only those who are first class can qualify. For it is an expensive matter, this training of men, and their responsibility will be great—and there must be little waste.

The French war office figures that a pilot and observer who, fully trained, mounted, and equipped, cross the enemy trenches for the first time represent a total investment of $25,000.

The British figure that a fully trained pilot represents an investment of $6,000, the observer $3,000, and the two-seated machines $10,000, which with other overhead expenses, bring the figures to the same total as the French. If for no other than financial reasons, the tremendous importance of the ground schools must be appreciated, not only in laying the proper foundations of this training but in weeding out the poor material and making the utmost of the good material.

After eight weeks of training and a stiff examination, the candidate learns his fate. Perhaps only 16 or 17 of the original class of 25 remain to graduate. But those who do have mastered the basic principles of military aeronautics, which, as Army men are learning more thoroughly every day, is a vital pre-requisite to any training in the air.

Successful ground-school graduates are enlisted in the Signal Corps or the Signal Enlisted Reserve Corps, where their status is that of "flying cadets." As soon as they pass the test for reserve military aviators they receive an officer's commission, with the regular pay and what is known as commutation of quarters at all places where no public quarters are available.

In the case of foreign duty, a ten per cent extra allowance is provided for by law to officers serving beyond the limits of the United States with the exception of the Canal Zone, Panama, Porto Rico, or Hawaii. In addition aviation officers on duty requiring them to participate regularly and frequently in aerial flights receive a 25 per cent increase in the pay of their grade.

It is a big job America has undertaken—to create out of nothing a huge fleet of planes, and an army to fly and observe in them. It has been said abroad that we couldn't do it—in time. But it hasn't been said lately. Since the first foreign missions came over and observed America and America's methods there has been a change of feeling as to what we could and couldn't do. And in place of being skeptical, the Allies have sent us their best aviation experts to assist us in doing what at first they said we couldn't do.

Of course, we can do it, will do it—are doing it. And while the flyer in the air, dropping bombs or fighting a duel, is the spectacular end of the training, it is the ground school which lays the foundation and which, almost unknown to the general public, is doing a work of military importance second to none in the final creation of America's aerial fighting corps.

Dr. Hugh Robert Mills

DR. Hugh Robert Mills, the veteran British geographer and meteorologist and director of "British Rainfall," has been awarded the Symons gold medal of the Royal Meteorological Society. This medal is conferred every two years; alternately on a British and a foreign meteorologist.

"Science Records Every Vital Move I Make"

Uniform Mileage
The Crowning Tire Triumph
Due to Uniform Tires—Built by Champions

A MIGHTY response has greeted the Miller announcement that Uniform Tires are now an achieved fact. That this world-gift is ready—that stabilized mileage is here after years of vain trials.

Previously, Miller Tires varied in mileage as others do.

Now 99 Millers in 100 outrun standard guarantees.

Run two Millers on opposite wheels and you shall see. Thousands of tests like this prove Miller mileage is stabilized.

Miller UNIFORM MILEAGE Tires
GEARED-TO-THE-ROAD

Mechanical methods do not account for this triumph. For they are shared by all makers.

But tires contain much handwork. And Miller has excelled by conquering "human variables."

To make workmanship uniform, we had to make workmen uniform. We had to take picked men only. Then we had to make each man a master tire builder.

Tires 99% Excellent

Today these Miller experts are called champions.

Their personal efficiency averages 96 per cent. If a tire comes back their rating is penalized. But less than 1 per cent of the tires they build ever need adjustment. That means that Millers are 99 per cent excellent.

Geared-to-the-Road

In addition to stabilized mileage, Miller Tires give utmost safety. One reason is they are geared-to-the-road.

Their ratchet-like tread engages the ground as you go. This counters the tendency to skid.

Few Can Get Them

Such tires as these cannot be produced where quantity output rules. For picked men are rare. It takes years to make champions.

If you want to be ***sure*** of getting Millers this year you must reserve your supply at once.

Only enough for one motorist in 50 will be made this year.

Miller Cord Tires are the fine, big fellows with the extra large air-capacity. There is nothing more luxurious, yet they cost less per mile than the regulation type.

THE MILLER RUBBER CO., Akron, Ohio
Makers of Miller Red and Gray Inner Tubes, The Team-Mates of Uniform Tires
Branches and Distributors In All Principal Cities

We Must "Follow-Up"

The story of the Gallipoli withdrawal is a tale of inadequate support. Like Salamanders clinging to the red-hot bars of a fiery furnace, the boys of Australia and New Zealand clung to the slopes of Anzac. Desperately, heroically they clung. No troops under any circumstances ever displayed greater soldierly qualities or upheld more sacredly the best traditions of England's Army. But they had to withdraw because the "follow-up" was not there.

To some of us it has been given to march with the columns of troops that go to France. And to others it is given to wave Godspeed. But he who marches and he who stays is equally a citizen of the world's mightiest republic and equally responsible for its success in this greatest of undertakings.

Then let us at home turn from our flag waving and consider how necessary we are, how useful we must be. Those who go to fight cannot hope to win by naked bravery and we cannot hope to win unless every individual at home does *all* he can. We must have no Gallipoli.

The Bell System is only one of the myriad great and small industries which are co-operating that nothing be left undone to keep a constant, efficient stream of men, guns, ammunition, food, clothing and comforts flowing to the front.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy *One System* *Universal Service*

Monoplanes and Biplanes

Their Design, Construction and Operation. The application of aerodynamic theory, with a complete description and comparison of the notable types. By Grover Cleveland Loening, B.Sc., A.M., C.E. 6¼ x 8¼ inches. Cloth. 331 pages. 278 illustrations. $2.50.

This work covers the entire subject of the aeroplane, its design and the theory on which its design is based, and contains a detailed description and discussion of thirty-eight of the more highly successful types.

MUNN & CO., Inc., *Publishers*, Woolworth Bldg., New York City

WONDER Pipe Bender

Saves the Cost and Waste of Elbow Joints

Bends 2" pipe COLD to 90° in one minute. Handles any length steel, iron brass or copper pipe. No heating, threading, cracking or crimping.

Used by U. S., English, French and Canadian, Governments—and many leading Firms.

3 sizes ½" to 1", ¾" to 2", 2½" to 4".

Write for Price List and Catalog

Reliable Agents Wanted Everywhere

AMERICAN PIPE BENDING MACHINE COMPANY
53 Pearl St., Boston, Mass.

BOSTON HOTEL LENOX

Almost the first thing you see is the welcoming sign of The Lenox, Boston's social center. Near everything worth while.

Three minutes' walk from the Back Bay stations and convenient to all theaters.

Home-Like Rooms — Choice Cuisine
L. C. Prior, Managing Director
Hotel Brunswick Same Management

The Motor Truck on the Farm

(*Concluded from page 76*)

produce waiting for it at each previously designated stop. The truck is used for general hauling in the winter time in order to keep it in operation and profitably employed. It is stated that the three-ton truck shown has earned as much as $60 in one day.

On some very large farms it is possible to use five-ton trucks to advantage and in order to supplement their normal capacity, if the character of the roadways permits they can haul loaded tractors of the same capacity as the truck, without imposing any serious strains on the truck mechanism or greatly increasing the cost of operation. The modern farmer is not slow in adopting labor saving machinery wherever it can be used to advantage and for this reason it is to be expected that motor trucks will be widely used in making long hauls. This condition of affairs is evident in the neighborhood of any of our large cities. Most of the produce farms on Long Island, for example, which are within a radius of twenty to twenty-five miles of New York city and Brooklyn, and which supply a large part of the produce for these cities, utilize motor trucks to advantage. This is made possible because of the level character of the country and the good roads. In sections where the highways are not fully developed, horse-drawn vehicles might prove of greater practical value than motor trucks.

Chemists Answer Nation's Call

(*Concluded from page 70*)

The very eyes of the Army and Navy are dependent upon the chemist; for in these days of long range weapons the glass must be provided for the binocular, the range finder and the periscope. Ever since the start of the European war our chemists have been working on a formula for optical glass; and their efforts have been redoubled since our entry into the arena. Most of this material was brought from Germany and France, where it was made from secret formulae, but within the past six months we have worked out a scheme whereby enough of this highly important optical glass of American manufacture will be shortly available for the Army and Navy for several years.

The demand for American crude chemicals abroad and for all kind of barks and drugs used both in the arts and in medcines has raised condensation to the *n*th power. Once we sent chestnut bark abroad for tanning, and then we evolved the chestnut extract. But casks and bottles are more expensive and make much trouble in shipping, so now the chemist is evaporating his extract and sending it abroad in bags as a dry powder. Our makers of chemical apparatus for industrial use have kept pace with the chemists and have been developing new and wonderfully useful machines for quick purposes. Truly the American chemist quite as much as our boys in khaki is doing his bit towards helping Uncle Sam win the war.

Unique Plan To Save Coal

THOUSANDS of homes in this country are without coal; thousands of industries are working short time for the same reason. The chances of getting it are slim. Fuel Commissioner Garfield says that there is likely to remain a shortage of from thirty-five to fifty per cent of necessary fuel indefinitely. This is due to two causes—lack of coal cars and lack of labor at the mines.

In Albany, N. Y., recently, a conference was held by Governor Whitman and representatives of the State Grange, the Farm Bureau, the State Colleges of Forestry and the Conservation Commissioner to discuss ways and means of saving more than a million tons of coal by the substitution of wood. In this connection an experiment recently worked out by the Michigan Agricultural College will prove of interest. It was demonstrated that there was a large demand for stump wood in the larger cities of Michigan, especially Grand Rapids and Detroit, and that $2.15 per cord was offered for it by the dealers; and that about three dollars' worth of dynamite would blast out and break up stumps containing an average of eight cords of wood.

There are a good many advantages connected with this idea. Merely cutting down trees and using the wood for fuel may take care of a present pressing need, but the practice represents an economic loss in the end; whereas clearing stump land represents an economic gain because, after the wood is burned, there still remains the virgin farm land to be used in increasing the Nation's food products. Using stump wood for fuel not only conserves coal but it relieves freight congestion and releases many cars at present employed in the hauling of coal. True, some of the stump wood would have to be hauled by rail; but such haulage would be purely local and probably most of it would be by team haul, whereas coal shipments frequently have to traverse several states.

The New York conferees estimated that the cutting of one cord of wood from each acre of farm lots in New York State would in itself save 1,125,000 tons of coal. If coal could be saved proportionately in other states it can readily be seen that the coal conservation would foot up an immense aggregate and that railroad equipment that could be used for other purposes would be released to the extent of thousands of cars and many locomotives.

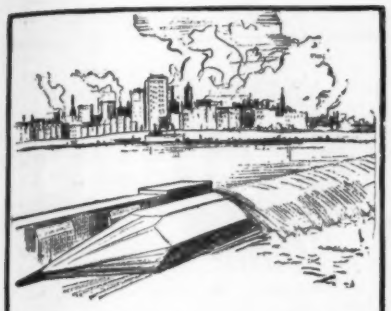
Owners of cut-over land, even if only small plots, will be interested in these suggestions. Probably the time will never again come when these stump lands can be cleared and made ready for cultivation not only at no cost to the owners but at an actual profit to them. In making that profit, they will be doing a favor to many householders in their locality who are unable to buy coal to heat their homes.

The Current Supplement

THE shortage of coal is very emphatically enforcing attention to methods of economy and efficiency in the use of fuel. A very promising step in this direction is the use of coal in pulverized form, a system that has been under investigation for a number of years. Many successful installations for the use of pulverized coal have been made, but so many of our manufacturers have been so busy of late making money that they have apparently had no time to consider methods of saving money. An article on *Pulverized Coal as a Fuel* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2194, for January 19th, places before our readers a great deal of practical and pertinent information on the subject. *The Emu in Captivity* is an interesting note of the experience at the New York Zoological Park with birds of peculiar habits. It is illustrated by several photographs. *Some Points in Photo-Copying* contains information of considerable value to the amateur photographer, and can be read with advantage by many professionals. *Bringing Ships from the Great Lakes to the Atlantic* tells how many big fresh-water vessels were passed through the short canal locks that barred their access to the ocean. Although considerable attention was attracted by the purchase by the United States of the Danish West Indies Islands, few people realized that we secured possession of only a portion of the group, and that a number of the islands are held by Great Britain. The article on *The Virgin Islands of Great Britain* supplies many little known facts in relation to the subject, and is accompanied by a chart that shows the exact situation. *Varying the Position of the Observer of the Heavens* gives some clear explanations that enable the observer to realize the direction in which he may be looking when observing the planets. There are a number of excellent explanatory diagrams, prepared especially for this article. The interesting paper on *The Biological Aspects of the War* is continued. There is a large amount of other valuable matter in this issue.

Philippines Wireless Time Service

SINCE October 1st, 1917, the Cavite radio station, sends out twice-daily time signals for the meridian of 120 East viz., at 11 A. M. and 10 P. M. The signals begin at five minutes before the hours named.



A Pencil Dammed the Mighty Mississippi

Before the great dam was constructed at Keokuk, a penciled plan had solved the problem. It directed every operation.

The pencil is of prime importance in making plans.

DIXON'S
ELDORADO
"the master drawing pencil"

does not smudge. It draws smoothly and clearly. The leads are strong and long wearing.

There is a perfect balance of smoothness, strength and wearing quality in each degree.

Send 16c in stamps for full-length samples worth double the money.

JOSEPH DIXON
CRUCIBLE COMPANY
Dept. 121-J, Jersey City, N. J.

DIXON'S BEST WHITE No. 352
writes white on blueprints

Valuable Books of Instruction and Reference

Scientific American Cyclopedia of Formulas—Concrete Pottery and Garden Furniture—Experimental Science—Handy Man's Workshop and Laboratory.

MUNN & Co., Inc., *Publishers*, Woolworth Bldg., New York

ASBESTOS

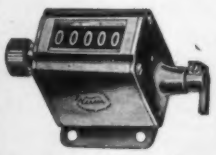
We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to
KEASBEY & MATTISON COMPANY
DEPT. S-1
AMBLER, PENNA, U. S. A.
Owners of the world's largest Asbestos Mines

How Increase The Output?

Watch it continuously—keep your machine at its *service-limit*—record its response to speeding-up methods by affixing this—

Veeder
COUNTER



Registers one for each revolution of a shaft, recording a manufacturing operation. Set back to zero by turning knob. Price, $5.

Every machine has its suitable Veeder Counter —all described for you in Booklet 18—free

THE VEEDER MFG. CO., 18 Sargeant St., Hartford, Conn.

Tin Scarcity and Recovery from Scrap

TIN in the form of pigs has sold in this last few weeks at the highest price in history, from seventy-five to eighty-five cents per pound. In view of its present scarcity and high price, methods of recovering it from old cans and tip scrap are receiving attention.

The municipality of Hornsey, England, under the direction of the borough engineer and surveyor, E. J. Lovegrove, has devised a practicable and profitable method of utilizing the empty tins that form a part of the refuse brought to the dust destructor. An important advantage of the process seems to be that it can be carried on with very little additional expense by municipalities that maintain an incinerator for the destruction of waste material. Its chief feature is a special furnace for the treatment of waste tin by gases, which can be added to the existing plant and worked in conjunction therewith, with only a trifling additional outlay in fuel and labor.

Mr. Lovegrove states that while "detinning," "desoldering," and "baling" are not new, the novelty in the process adopted in the district of Hornsey is that the detinning—that is, burning the tin off the steel—is done by means of heat from waste flue gases on their passage from the furnace to the chimney, thereby reducing the cost of a separate and specially fired furnace. As adopted by the Hornsey town council the process involved only a comparatively nominal capital outlay (under $1,000), the hydraulic pressure being already installed at the works in connection with other machinery. The process is protected by patent in England, and rights are being taken out for foreign countries.

"In order to describe the process," says its inventor, "it will be convenient to deal with a typical case of 100,000 population. The quantity of scrap collected from the house refuse at the furnaces, which must necessarily vary according to the class of town and population, is about two hundred tons per annum, which may be divided approximately as follows: Tin, 135 tons; light scrap, 30 tons; galvanized scrap, 25 tons; enamel scrap, 10 tons; total 200 tons.

"The cans are detinned by heat. In this district they are sorted out on the top of the delivery platform and dropped into a furnace, through which the flue gases are allowed to pass. The heat melts off the solder, which falls into a collecting trough. The cans are then removed and put through a hydraulic press and formed into bales 2 feet 3 inches by 15 inches and about 4 inches deep. When removed no banding is necessary, as the bales hold together in such a way that they can be put into a lorry and thence taken to railway trucks for delivery to the steel works. The solder that is collected in the trough has necessarily a certain quantity of dross in it, from which it has to be separated to find a ready market. The light scrap is merely sorted out and baled without treatment of any kind and similarly forwarded to the steel works. The galvanized scrap is baled without treatment and delivered to degalvanizing works. The enamel scrap has to be specially treated by firms dealing in such material, who remove the enamel and recover the steel.

"Dealt with in this way, the recovered metal produces a revenue in this district of upward of $1,000, thus doing away with the necessity of paying for the cartage of material to waste tips, which still obtains in many districts. The plant installed at Hornsey, by the adoption of the above-mentioned furnace in connection with the destructor plant, has rendered possible the carrying out of the work as part of the depot routine, no additional labor having been employed. The prices obtained, however, are somewhat low on account of the distance of the town to the nearest steel works—say, about 200 miles—so that towns more fortunately situated would obtain a larger revenue. It will be noted that the flue gases from a dust destructor are used, but the same principle may be applied to the waste gases from any furnace, boiler, or the like at works where there is a large output of waste cans to be dealt with."

An Epoch-Making Factory

The first factory ever built, embodying a practical method of lighting and ventilating a virtually unlimited floor space by purely natural means.

Its product is the Delco Light for country homes. For the skill and rapidity required of the workers abundant fresh air and light are necessary.

It will be, eventually, six times its present size, or 870 by 2000 feet, all under one continuous 40-acre roof. Yet there will not be a dim or stuffy corner in the building.

Air and light enter, and air is discharged, through openings in the roof itself. The inverted roof slopes, leading directly to the outlets, insure complete scavenging of stale air and prevent cross winds from blowing through.

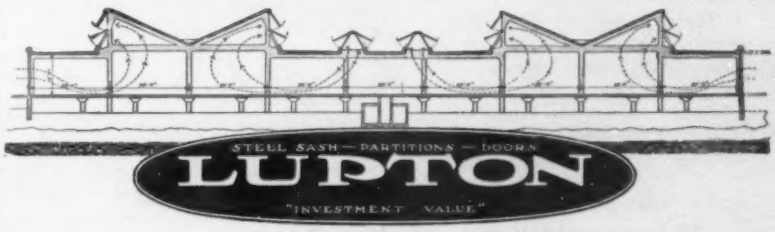
Both outlets and inlets are protected by weatherproof continuous sash, controlled in unbroken lines of 400 and 600 feet by electric motor-driven operating device. Being of equal area, they ensure uniform air renewal throughout the entire floor. The lighting effect is shown by the interior photograph.

This remarkable building is described, with a number of others having better than usual lighting and ventilation, in a booklet, "Air, Light and Efficiency." Free on request.

DAVID LUPTON'S SONS CO.
Clearfield and Weikel Streets
Philadelphia, Pa.
Makers of equipment for daylighting and natural ventilation

Domestic Engineering Co., Moraine, O. Schenck & Williams, Architects. Present section 270 ft. wide, 1000 ft. long. Roof is a series of Pond Trusses, with Pond A-frame inlets between. Pond Continuous Sash, top hung and overlapping storm panels at the ends, used in all roof inlets and outlets, with Pond Operating Device, Motor Driven. Lupton Factory Sash in side walls.

Let us help solve your lighting and ventilating problems



1st 2nd

Choose the right make of hack saw—the Starrett.

STARRETT HACK SAWS

Be sure you use the right numbered Starrett.

Why?— because economy demands *Starrett Hack Saws*

suited to the work. See page 208 of Catalog No. 21B. It shows what saw to use for any shape or metal.

The L. S. Starrett Co.
The World's Greatest Toolmakers
ATHOL, MASS.

ADVERTISING CLASSIFIED

LATHES AND SMALL TOOLS

Friction Disk Drill

FOR LIGHT WORK

Has These Great Advantages.

The speed can be instantly changed from 0 to 1600 without stopping or shifting belts. Power applied can be graduated to drive, with equal safety, the smallest or largest drills within its range a wonderful economy in time and great saving in drill breakage.

Send for Drill Catalogue

W. F. & Jno. Barnes Company
Established 1872
1999 Ruby Street Rockford, Illinois

SOUTH BEND LATHES
Established in 1906. Making Lathes over 10 years

For the Machine and Repair Shop
LOW IN PRICE
13 in. to 24 in. swing Straight or Gap Beds.
Send for free catalog giving prices on entire line.
South Bend Lathe Works
421 Madison St., South Bend, Ind.

GOODELL-PRATT
1500 GOOD TOOLS

MASON'S NEW PAT. WHIP HOIST
for Outrigger hoists. Faster than Elevators, and hoist direct from teams. Saves handling at less expense.
Manufactured by VOLNEY W. MASON & CO., Inc.
Providence, R. I., U. S. A.

THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES
BRIDGEPORT CONN.

Print Your Own Cards, circulars, label, book, paper, $5. PRESS. Larger $20. Rotary $70. Save money. Print for others, big profit. All easy, rules sent. Write factory for catalog presses, TYPE, paper, cards.
THE PRESS CO., D-22 Meriden, Conn.

LEPAGE'S GLUE HANDY TUBES
WILL MEND IT

NOVELTIES & PATENTED ARTICLES
MANUFACTURED BY CONTRACT. PUNCHING DIES. LIGHT AUTOMOBILE STAMPINGS.
KONIGSLOW STAMPING & TOOL WORKS, CLEVELAND, O.

THE BRIDGEPORT CHAIN CO.
Specialists in Small Wire Shapes & Flat Stampings
Bridgeport, Conn.

Experimental and Model Work
Electrical Instruments and Fine Machinery.
Inventions Developed.
Special Tools. Dies, Gear Cutting, Etc.
HENRY ZUHR, 200 to 204 William St., New York City

WHEN DO FISH BITE BEST?
Get the 1918 OLD FISHERMAN'S CALENDAR. It tells WHEN. Thousands of old fishermen know the best weeks to go fishing. Why not YOU? Send 25c. (coin carefully wrapped) or money order to
OLD FISHERMAN'S CALENDAR
Box 944 H Sta. Springfield, Mass.

WELL DRILLING PAYS **WELL**
Own a machine of your own. Cash or easy terms. Many styles and sizes for all purposes
Write for Circular.
WILLIAMS BROS., 434 W. State St., Ithaca, N.Y.

SPEED UP PRODUCTION
Noisy, inefficient toothed gears hold down the production in your plant.
Rockwood
Friction Transmission
solves the problem, increases efficiency, speeds up production and costs less to buy and less to maintain than toothed gears.
Our 92 page book "Friction Transmission" has valuable information for you—Send for it. Give firm connection.
THE ROCKWOOD MFG. CO.
1904 English Ave., Indianapolis, Ind., U.S.A.

FOREIGN COMMERCIAL NOTES AND QUERIES

The SCIENTIFIC AMERICAN has always enjoyed a wide international circulation. Its voice is heard in the remotest corners of the earth. Now that American manufacturers have been stirred to the advantages of international expansion we are anxious to do our part in bringing American products into foreign markets. Hence this department has been established to pave the way for American trade expansion to all quarters of the globe.

Those who are interested in the trade opportunities listed in this column, can obtain the names and addresses by complying with the following simple rules: 1. Write only one inquiry on a sheet. 2. Always give the serial number. 3. Write on your own business letterhead. The SCIENTIFIC AMERICAN assumes no responsibility for the financial standing of concerns or individuals. Address all communications to the Query Editor of the SCIENTIFIC AMERICAN, Woolworth Building, New York.

751.—An agency is desired by a commission agent in Spain for the sale of printing presses. Correspondence should be in Spanish. References.

752.—An agency is desired by a man in France for the sale of printing presses, book-binding machines, paper-cutting machines, and all kinds of machines for the printing business. Correspondence should be in French.

753.—A firm in India wishes to purchase match-making materials and machinery, such as chlorate of potash, bichromate of potash, powdered sulfur, potato starch, yellow dextrine, gum acroids, infusorial earth, glass powder, phosphate ammonia, black antimony, rhodamine dye, golden sulfide of antimony, zinc white, asbestos powder, manganese, amorphous phosphorus, caput mortum, leather glue, gum senegal and gum tragacanth, green straw paper, blue paper, brown paper sheets, match-box labels, etc. Also parts for match-dipping machines, peeling and veneer cutting machines, and box composition painting machines. References.

754.—A man in Spain desires to secure an agency for the sale of watches and clocks. Correspondence should be in Spanish. References.

755.—A company in India desires to be placed in communication with American manufacturers and exporters of machinery and equipment for making frame molding. References.

756.—An engineer in France wishes to purchase complete milling machines and equipment for a large milling plant, such as conveyors and all kinds of other apparatus for such an installation. Correspondence should be in French.

757.—A man in Portugal is in the market for ore crushing and concentrating machinery. Quotations should be made f. o. b. New York. Payment will be made against documents. Correspondence may be in English. Catalogues and price lists should be submitted. Reference.

758.—The Department of Harbor and Docks of a city of Norway desires to purchase a number of cranes, varying from ½ to 1½ tons capacity, mounted on trucks and operated with storage batteries for use in the harbor, mounted so that they can be transferred from one place to another. Correspondence may be in English.

759.—A retail buyer in Italy is in the market for copper bath heaters, using coal and wood; electric, silk-covered wire, 200 volts, usual diameter; electroliers of novelty shape; nickeled taps for water; porcelain bathroom fittings, such as tubs, water-closets, washstands, lavatories, etc. Quotations should be made f. o. b. New York. Terms, bank credit against shipping documents. Correspondence should be in French or Italian. References.

760.—A company in England wishes to buy outright, or to secure the sole agency for ceiling fans, 220 volts, 180/200 watts, 4 wooden blades 56/8 inch sweep, with hanger and canopy sans down rods; desk fans, 16 inches, 220 volts; fan regulators, 5 points, 220 volts; electric lamps, 5 to 50 cp., 110 and 220 volts, per 1,000; bracket electrical fans; and also ½-watt lamps. Quotations should be made f. o. b. New York. Terms, cash in New York against shipping documents. Reference.

761.—A railway purchasing commission in Switzerland is in the market for railway equipment and accessories for ordinary and electrical railways, such as wheels, axles, rails, car outfits, etc., in large quantities, if possible in European measurements. Quotations should be made f. o. b. New York. Correspondence should be in French or German. References.

762.—An agency is desired by a company in Portugal for the sale of automobiles. Quotations should be made f. o. b. American port. Payment will be made by cash or credit terms. Correspondence may be in English. References.

763.—A chamber of commerce in France wishes to be placed in communication with American manufacturers and exporters of cotton yarn. Full information in regard to prices, freight rates, etc., should be submitted.

764.—A firm in India desires to secure an agency on a commission basis for the sale of canned food products of all kinds, such as meats, fish, vegetables, etc. Quotations should be made f. o. b. port of shipment. Payment will be made by cash against documents. Correspondence may be in English. Reference.

765.—A man in France wishes to represent American manufacturers and exporters of construction materials, such as cement, structural iron, etc.; and food products, such as flour, grain, and canned goods. All business is desired on a commission basis. Correspondence should be in French. References.

766.—A firm in Brazil wishes to be placed in communication with American manufacturers and exporters, with a view to securing an agency for the sale of their goods. It is at the present time in need of 500 alarm watches of cheap make. Catalogues, prices, and full information should be submitted as soon as possible. Bank credit will be opened in favor of American firm, payment being made for goods by cash against shipping documents in the United States. Correspondence should be in Italian, Portuguese, or Spanish. Reference.

767.—A man in France desires to represent American manufacturers and exporters of a general line of goods, such as food products, greases and oils, industrial chemicals, cereals, general light hardware, etc. All business is desired on a commission basis basis. Correspondence should be in French. References.

768.—A man in France desires to secure an agency for the sale of cistern wagons with a capacity of 150 hectoliters each. Quotations should be made f. o. b. New York. Payment will be made against documents. Correspondence should be in French. References.

769.—A man in France desires to purchase dyes derived chiefly from dye-woods such as campeche, indigo, aniline, and others. Samples, catalogues, and price lists should be submitted. He would consider an agency proposition. Quotations should be made f. o. b. New York. Correspondence should be in French. References.

LEGAL NOTICES

OVER 70 YEARS' EXPERIENCE
PATENTS
TRADE MARKS
DESIGNS
COPYRIGHTS &c.

INVENTORS are invited to communicate with **Munn & Co., 233 Broadway, New York,** or **625 F Street, Washington, D. C.,** in regard to securing valid patent protection for their **Inventions. Trade-Marks** and **Copyrights** registered. **Design Patents** and **Foreign Patents** secured.

A Free Opinion as to the probable patentability of an invention will be readily given to any inventor furnishing us with a model or sketch and a brief description of the device in question. All communications are strictly confidential. Our **Hand-Book** on Patents will be sent free on request.

Ours is the **Oldest** agency for securing patents; it was established over **seventy** years ago.

All patents secured through us are described without cost to patentee in the **Scientific American.**

MUNN & CO.
233 Broadway Woolworth Building New York
Branch Office: 625 F Street, Washington, D. C.

Annual Subscription Rates for the Scientific American Publications

Subscription one year $4.00
Postage prepaid in United States and possessions, Mexico, Cuba and Panama.
Subscriptions for Foreign Countries, one year, postage prepaid $5.50
Subscriptions for Canada, postage prepaid ... 4.75

The Scientific American Publications

Scientific American (established 1845) $4.00
Scientific American Supplement (established 1876) 5.00
The combined subscription rates and rates to foreign countries, including Canada, will be furnished upon applicatin.
Remit by postal or express money order, bank draft or check.

Classified Advertisements

Advertising in this column is $1.00 a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

POSITIONS OPEN

The Western Electric Company, Incorporated, has opportunities for physicists, engineers, designers, and draftsmen, for work of research, development, and design related to problems of telephonic, telegraphic and radio communication which are matters of public importance. Both temporary and permanent positions are open. Apply by letter, not in person unless so specifically requested, to F. B. Jewett, Chief Engineer, 463 West St., New York, N. Y.

LEARN TO BE A WATCHMAKER
Bradley Polytechnic Institute—Horological Department
Peoria, Illinois
Largest and Best Watch School in America

(*This entire building used exclusively for this work.*)
We teach Watch Work, Jewelry, Engraving, Clock Work, Optics. Tuition reasonable. Board and rooms near school at moderate rates Send for Catalog of Information.

Magical Apparatus
Send 25c for "Grand Catalogue"
200 pages—600 Engravings, Tricks, Illusions
Ventriloquial figures, Catalogue Parlor Tricks Free
MARTINKA & CO., Estab. 1875, 493 Sixth Ave., New York

Manufacturers

Would it be of value and assistance to you to have a classified set of United States Patents relating to your particular line of manufacture for ready reference? If so, write to our Manufacturers' Service Department for particulars.

MUNN & CO.
PATENT ATTORNEYS
626 Woolworth Building
New York City

STANDARDIZATION

The Great War's Greatest Lesson

The whole world is awakening to the importance of standardization, the guiding policy of the Continental Motor. Based upon the best engineering thought of both Europe and America, this motor embodies, in standardized form, the technical knowledge of our entire generation.

Scores of manufacturers of motor trucks and passenger cars, thousands of dealers, hundreds of thousands of owners, through Continental power, multiply their own power. They thus bear living testimony to Continental efficiency and confirm its title as America's Standard Motor.

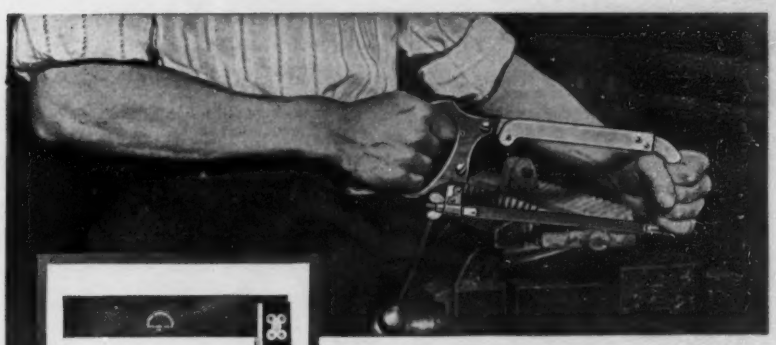
CONTINENTAL MOTORS CORPORATION

OFFICES: Detroit, Michigan — FACTORIES: Detroit—Muskegon

Largest exclusive motor manufacturers in the world

Continental Motors

CONTINENTAL MOTORS — Power of the Nation — AMERICA'S STANDARD



A Disston Hack-Saw will do the work

Disston metal-cutting saws serve the metal industries of the world. Steel rails are cut to correct lengths by Disston circular rail saws in the great Pittsburgh mills; steel girders are cut with Disston milling saws.

Disston hack-saw frames are built to last and to stay rigid. Disston hack-saw blades are made of Disston alloy crucible steel, hardened and tempered by a special process. The teeth are milled and have just the right shape and pitch for fast, easy cutting. Disston machine hack-saw blades are the dependence of machinists for their heavier work.

Send for our free Hand-Saw Booklet. It tells you how to select, use, and care for saws and the other Disston tools.

HENRY DISSTON & SONS, Inc., Philadelphia, U.S.A.

Canadian Works, Toronto, Canada

Chicago — Cincinnati — Boston — San Francisco
Memphis — New Orleans — Seattle — Portland, Ore.
Vancouver, B. C. — Sydney, Australia

DISSTON

DISSTON SAWS AND TOOLS

Just Published — *A New Book for Aviators*

Aviation Engines

THEIR DESIGN, CONSTRUCTION, OPERATION AND REPAIR

By Lieutenant VICTOR W. PAGE

Aviation Section, S. C., U. S. R.

600 Octavo Pages. 253 Specially Made Engravings.

Price, $3.00 net, Postpaid

THE rapidly increasing interest in the study of aviation, and especially of the highly developed internal combustion engines that make mechanical flight possible, has created a demand for a text-book suitable for schools and home study that will clearly and concisely explain the workings of the various aircraft engines of foreign and domestic manufacture.

This treatise, written by a recognized authority on all of the practical aspects of internal combustion, engine construction, maintenance and repair, fills the need as no other book does. The matter is logically arranged; all descriptive matter is simply expressed and copiously illustrated, so that anyone can understand airplane engine operation and repair even if without previous mechanical training. This work is invaluable for anyone desiring to become an aviator or aviation mechanician.

The latest rotary types, such as the Gnome Monosoupape and LeRhone, are fully explained, as well as the recently developed Vee and radial types. The subjects of carburetion, ignition, cooling and lubrication also are covered in a thorough manner. The chapters on repair and maintenance are distinctive and found in no other book on this subject.

Invaluable to the student, mechanic and soldier wishing to enter the aviation service.

Not a technical book, but a practical, easily understood work of reference for all interested in aeronautical science.

Munn & Co. Inc. *Woolworth Building* **233 Broadway, N. Y.**

World Wide Distributing Facilities

are afforded American Manufacturers and Merchants through

Gaston, Williams & Wigmore, Inc.

120 BROADWAY, NEW YORK CITY

International Merchants

Exporters Importers Shippers

American Business houses provided with excellent facilities for the systematic world-wide distribution of "Made-in-America" products.

Foreign manufacturers and merchants can secure distribution of their products in the United States through our perfected importing facilities and efficient sales organization.

REPRESENTED IN

London, Paris, Rome, Petrograd — Madrid, Lisbon, Moscow, Tokyo — Shanghai, Vladivostok, Cape Town, Valparaiso — Caracas, Cali, Barranquilla, Guayaquil — Lima-Iquitos, Oruro

And the ten principal cities of Brazil

GLOBE LINE

Owned by GASTON, WILLIAMS & WIGMORE STEAMSHIP CORPORATION

G W USA W Inc.

35 - 37 - 39 BROADWAY NEW YORK

TORBENSEN INTERNAL GEAR TRUCK DRIVE

44,257 trucks have TORBENSEN DRIVE—

Torbensen Drive is unchanged and unchanging. Everyone of these 44,257 axles—now in use—represents a fundamental, fixed idea of construction from which we have never departed. It is a far greater number than any other type of truck axle on the market.

Torbensen is the *one* drive for every service. It will give you superior satisfaction and service whatever the size of your truck or the duty it is called upon to perform.

Torbensen-equipped trucks plow along steadily, year-in-year-out, in summer heat and winter cold. They go over rough roads and smooth, through heavy, city traffic and at higher speed, through the open country.

Sheer strength, common-sense design, fool-proofness, the faith of the makers of thousands of the best trucks—these are the facts behind Torbensen Drive—the reasons why you should buy trucks with Torbensen Drive. They are money-saving trucks that *make* good.

We have a very interesting booklet about TORBENSEN Drive—"Driving *at* the Wheel and *near* the Rim." It explains every detail in simple language. Your copy will be mailed the minute your request reaches us.

THE TORBENSEN AXLE CO.
CLEVELAND, OHIO

A solid-forged I-Beam is the unyielding steel backbone of Torbensen Drive. It carries *all* the load. It does *nothing* else.

A jackshaft with pinions on its ends does *all* the *driving* through the internal gears. It does *nothing* else. It carries *no* load whatever.

These members, held in practically perfect, permanent alignment, form the famous Torbensen Drive.

This drive is as simple as any good drive can be. All its parts are easily accessible. It is easy to take apart and easy to put together again.

Seventeen years of ever-growing service have *proved* that Torbensen Drive makes trucks last longer, makes rear tires give 20% greater mileage and reduces gas and oil consumption.

TORBENSEN Drive is made to last. Every owner gets a GOLD BOND GUARANTEE that the I-BEAM axle and spindles will last as long as the truck, and the internal gears at least two years.

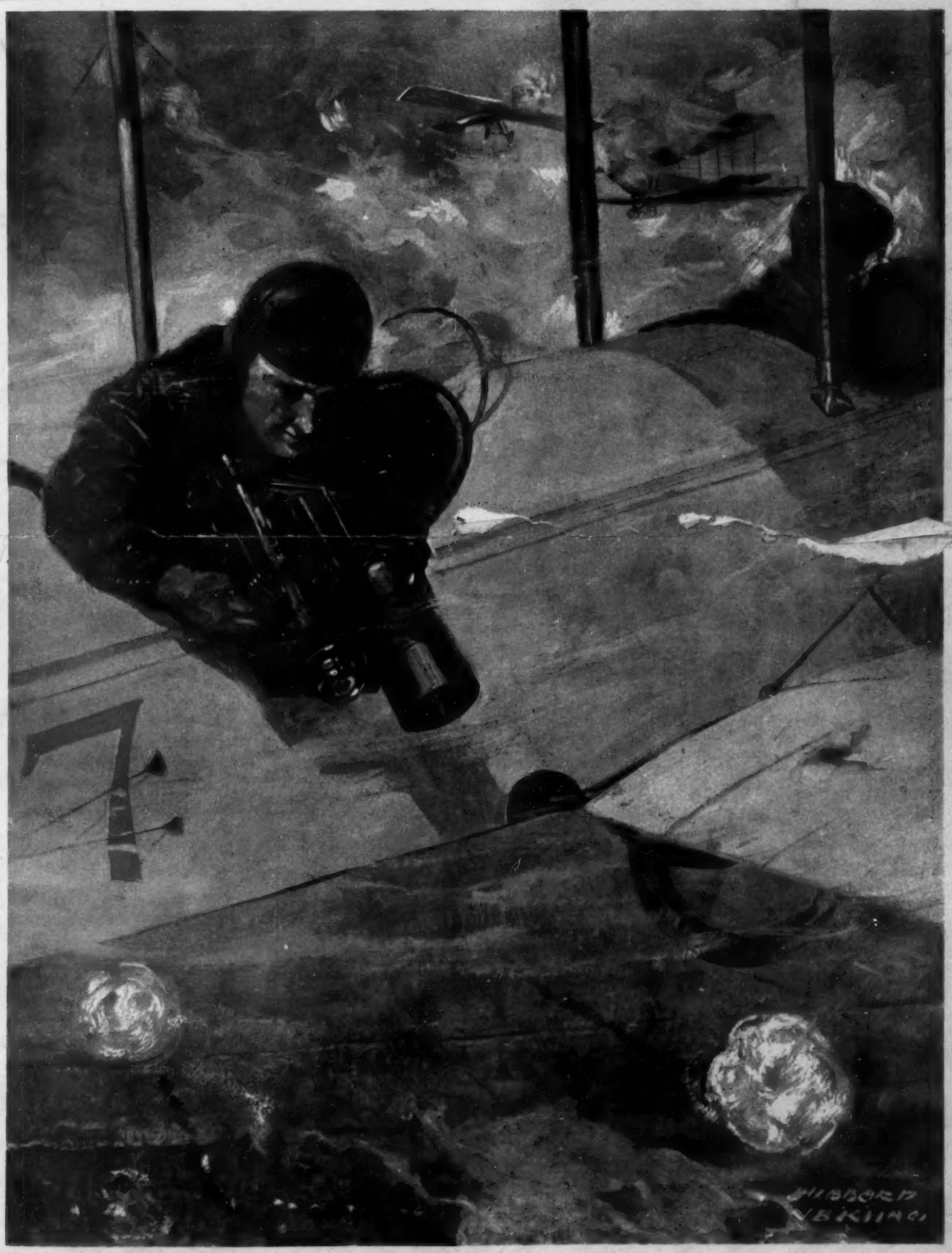
Largest Builder in the World of Rear Axles for Motor Trucks

Our subscribers are requested to note the expiration date that appears on the wrapper in which they receive their copies of SCIENTIFIC AMERICAN. If they will send in their renewal orders at least two weeks prior to the date of expiration, it will aid us greatly in rendering them efficient service.

JAN 28 1918.

NOTICE TO READER
When you finish reading this magazine, place a one-cent stamp on this notice, hand same to any postal employee, and it will be placed in the hands of our soldiers or sailors at the front. NO WRAPPING—NO ADDRESS.
A. S. BURLESON, Postmaster-General.

SCIENTIFIC AMERICAN



TAKING PHOTOGRAPHIC NOTES ON A RECONNAISSANCE FLIGHT [See page 91]

January 26, 1918

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

If you ever wake up to this, blame it on someone's inflammable roof

IN the last few years thousands of people of Atlanta, Baltimore, Salem and Paris looked helplessly on just such a sight—stood powerless while their homes, workshops and landmarks were eaten alive by the red scourge. So long as we are human, carelessness, oversight and combustibles will be with us. So will fire. And while a single burned home or gutted factory is a severe loss to the individuals involved, the community fire is a real catastrophe. And it isn't an accident. It is the price charged by ignorance for a lesson in fire safety.

All such fires start small and spread large over the Inflammable Roof Route. Your home's protection from the community fire depends on the material fastened to its rafters. Your factory's chance in a conflagration depends on its roof material.

The modern roof has outgrown its function as a weather protection—it must be a fire preventative as well—and this is a specification for Johns-Manville Asbestos Roofings, resistant to heat, weather, and time. This modern roof is one of the biggest single contributions to fire-safe construction, and explains why slowly but surely the fire peril is lessened and the day comes nearer when it will flicker out.

H. W. JOHNS-MANVILLE CO.
NEW YORK CITY
10 Factories—Branches in 60 Large Cities

Safeguard your property with one of these Johns-Manville Asbestos Roofings—Asbestos Built-Up Roofing, Asbestos Ready Roofing, Corrugated Asbestos Roofing, Colorblende and Transite Asbestos Shingles

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

JOHNS-MANVILLE

Service in Fire Prevention